TEXAS AGRICULTURAL EXPERIMENT STATION
A. B. CONNER, DIRECTOR,
College Station, Texas

FIFTY-THIRD ANNUAL REPORT
1940

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INSTITUTE

AGRICULTURAL AND MECHANICAL COLLEGE OF TEXAS
T. O. WALTON, President

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TEXAS AGRICULTURAL EXPERIMENT STATION

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July 1, 1941

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* In cooperation with U. S. Department of Agriculture.
** On leave.
†In cooperation with U. S. Department of Interior.

Members of Teaching Staff Carrying Cooperative Projects on the Station

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L. J. McCall, Farm Supt.

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V. L. Cory, M. S., Range Botanist
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O. L. Carpenter, Br. Supervisor

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T. E. Denman, B. S., Hort.

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A. H. Alex, B. S., Queen Breeder

East Texas Pasture Inv., Lufkin:

E. K. Crouch, B. S., Agron. in charge

Truck Crop Insect Inv., Alta Loma:

M. J. Janes, Ph. D., Entom. in charge

Loco Weed Research, Alpine:

*F. P. Mathews, Ph. D., Vet. in charge

Tomato Disease Inv., Jacksonville:

P. A. Young, Ph. D., Pl. Path. in chg.

Tomato Disease Inv., Yoakum:

A. L. Harrison, Ph. D., Pl. Path. in chg.

Sweet Potato Inv., Gilmer:

R. E. Wright, M. S., Hort. in chg.

Fruit Investigations, Montague:

U. A. Randolph, B. S., Hort. in chg.

Cotton Insect Inv., Presidio:

*A. J. Chapman, B. S., Assoc. Entom. in charge

Livestock Feeding Inv., Big Spring:

*F. E. Keating, B. S., Assoc. Agron. in chg.
*Jot Smyth, Jr., Agt. in An. Husb.

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* In cooperation with U. S. Department of Agriculture.

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FIFTY-THIRD ANNUAL REPORT, 1940

A. B. Conner, Director

The Texas Agricultural Experiment Station is the organized agricultural research agency of the State of Texas. It is one of the major divisions of the Agricultural and Mechanical College of Texas. Its work at the Main Station is supplemented by work in field areas at seventeen substations and ten field laboratories. In addition, there is considerable work at other points in cooperation with other State institutions.

Organized agricultural research is the source of reliable information and facts which are necessary for the proper and orderly development of the agricultural resources and opportunities of the State. It points the way to sound procedure in farming and ranching operations and opens up new fields for the development of industrial enterprises, particularly those concerned in the processing and handling of agricultural products. It serves as a basis for instruction in agriculture. It serves the Extension Service as a basis for putting into practice the findings of research. It serves to support and strengthen vocational agriculture instruction in the public schools, and finally it is of service and value to any and all agencies engaged in the development, conservation, and use of our agricultural resources.

It is of the utmost importance that we build our agriculture to a high standard of efficiency for the benefits that may accrue to the individual operator and only on such a basis can the general welfare of the State and the Nation be best served. The degree of efficiency on which we conduct our farm and ranch operations affects the welfare of all the people under any conditions that may exist, and it may well be said that research points the way to greater efficiency in agriculture and the fullest realization of the opportunities from the fruits of our labors in the field of agriculture.

The following report is intended to be a very brief, concise statement of the progress of work during the year in the several lines of research engaged in by the Agricultural Experiment Station system.

ORGANIZATION AND WORK

The Agricultural Experiment Station System comprises the Main Station with twenty divisions at College Station, seventeen substations in the several agricultural regions of the State, and ten field laboratories, as follows:

Divisions

Administrative
Veterinary Science
Chemistry
Horticulture
Range Animal Husbandry
Entomology

Agronomy
Plant Pathology and Physiology
Farm and Ranch Economics
Soil Survey
Botany
Swine Husbandry
Dairy Husbandry
Poultry Husbandry
Rural Home Research
Apiculture
Feed Control Service
Agricultural Engineering
Wildlife Research
Publications

Substations

No. 1, Beeville, Bee County
*No. 2, Tyler, Smith County
*No. 3, Angleton, Brazoria County
*No. 4, Beaumont, Jefferson County
*No. 5, Temple, Bell County
*No. 6, Denton, Denton County
*No. 7, Spur, Dickens County
No. 8, Lubbock, Lubbock County
No. 9, Balmorhea, Reeves County
No. 10, College Station, Brazos County
No. 11, Nacogdoches, Nacogdoches County
*No. 12, Chillicothe, Hardeman County
*No. 14, Sonora, Sutton-Edwards Counties
No. 15, Weslaco, Hidalgo County
No. 16, Iowa Park, Wichita County
*No. 19, Winter Haven, Dimmit County
No. 20, Stephenville, Erath County

Field Laboratories

*Apiculture Research Laboratory, San Antonio, Bexar County.
Truck Crop Insect Investigations Laboratory, Alta Loma, Galveston County.
*Cotton Insect Laboratory, Presidio County.
*Loco Weed Laboratory, Alpine, Brewster County.
East Texas Pasture Investigations Laboratory, Lufkin, Angelina County.
Tomato Disease Laboratory, Jacksonville, Cherokee County.
Tomato Disease Laboratory, Yoakum, Lavaca County.
*Sweet Potato Laboratory, Gilmer, Upshur County.
Fruit Investigations Laboratory, Montague, Montague County.
*Livestock Feeding Investigations Laboratory, Big Spring.

VETERINARY SCIENCE

Loin Disease in Cattle

Work on this project during the year has been largely with purification of cultures.

H. Schmidt.

Infectious Bovine Abortion

(In cooperation with School of Agriculture, A. & M. College of Texas.)

Observations of the dairy herd of the Feeding and Breeding Station and of the dairy herd of the A. & M. College were continued during the year. There were 59 calvings in the Feeding and Breeding Station dairy herd and no abortions and all cows gave a negative agglutination test to Bang's disease.

*In cooperation with United States Dept. of Agriculture.

In the A. & M. College dairy herd a number of agglutinations on all cows were run during the year. These all continued negative with the exception of the last test which was run in December, 1940, on which test three young heifers recently bred and one mature cow gave a positive reaction. Under the prevailing conditions these reactions cannot be interpreted at the present time. Ten abortions occurred in the herd during the year but all aborting cows gave a negative agglutination test, thus indicating that Bang's disease was not involved in these abortions; neither could trichomonads be demonstrated. It is assumed that these abortions were due to some cause other than an infectious one. A number of tests in which it was sought to incriminate some other infectious agent were negative. Nevertheless an infectious agent is constantly kept in mind and efforts will be continued to detect it in case it should appear.

H. Schmidt, R. D. Turk, O. C. Copeland, C. N. Shepardson.

Trichomonad Abortion of Cattle

(In cooperation with School of Agriculture, A. & M. College of Texas.)

No additional positive cases have been found in the A. & M. College dairy herd during the past year. A case showing very suspicious symptoms was observed but the organisms could not be demonstrated in spite of repeated attempts. This case is being kept under observation.

H. Schmidt, R. D. Turk, C. N. Shepardson.

Effect of Moldy Feed on Sheep and Other Farm Animals

Work on this project has been interrupted on account of lack of material from the field. No case reports were received during the year and no new material was available.

H. Schmidt.

Swamp Fever in Horses and Mules

Work on this project has been suspended on account of lack of material but will be resumed when conditions and facilities permit.

H. Schmidt.

Loco Weed Poisoning

(In cooperation with Bureau of Animal Industry, U. S. D. A.)

Additional field experiments are under way to supplement some that had been previously conducted. In one experiment two pounds of cottonseed meal per head per day is being used and in another two pounds of black strap molasses per head per day under grazing conditions. In another pen-feeding experiment cows are being fed dry loco and three pounds of black strap molasses per head per day with the idea of preventing the development of locoism. The experiments have not yet been concluded.

Frank P. Mathews.

Jimmies in Sheep and Goats

(In cooperation with Bureau of Animal Industry, U. S. D. A.)

Warm weather and abundant rainfall frustrated attempts to conclude an experiment on this project last year. This year conditions have not been very much better but there are indications that a few animals on experiment will develop the trouble shortly. The main season for the trouble to begin is just arriving. The work is being continued.

Frank P. Mathews.

Poisonous Plants in the Davis Mountains

(In cooperation with Bureau of Animal Industry, U. S. D. A.)

During the year work on the red-stemmed peavine *(Astragalus emoryanus)* had advanced to a point where a paper was edited and published. Since publication of this article additional information has been gathered which indicates that this plant is not toxic under all conditions. Locations have been found from which animals could not be poisoned with it.

White brush *(Lippia ligustrina).*—A small area upon which the so-called white brush *(Lippia ligustrina)* grows abundantly has been located and fenced off. Two horses were placed into this enclosure and forced to feed upon the white brush, both of which became poisoned on this plant and died. Work with other animals is in progress.

Peganum harmala.—This plant has been found growing in the Davis Mountains area and is being investigated. Feeding experiments are not yet completed but are being continued.

Phyllanthus abnormis.—This plant is suspected of causing losses among cattle. Feeding experiments strongly indicate that it produces a condition closely resembling senecio poisoning. Senecio poisoning is, however, excluded due to the absence of this plant on the affected range.

Frank P. Mathews.

Stiff Sheep

(In cooperation with Bureau of Animal Industry, U. S. D. A.)

A condition in sheep has been discovered in which they show a tenderness of foot which causes them to avoid travel and going to water. The condition seems to be limited to certain areas and a number of plants from such areas have been fed experimentally. The condition, however, has not yet been produced artificially.

Frank P. Mathews.

Pathological Conditions Accompanying Vitamin Deficiencies

The pathological condition that is giving us the greatest concern at the present time is not so much night blindness as urinary calculi. Most of

our experimental animals, especially sheep and goats, begin to suffer from urinary calculi after they have been on a deficient ration for a number of months. In an experiment designed to test the influence of carotene in alfalfa on the occurrence of urinary calculi in castrated male goats, it was found that of seven animals on the deficient ration all but one died with urinary calculi within one year while none of those getting 2500 micrograms of carotene had died although three of them at one time showed symptoms indicating urinary calculi. Three of those that died of urinary calculi on the deficient ration either also had many calculi in the pelvis of the kidneys which caused atrophy of the organ or had the kidneys encrusted with the same. The work is being continued.

H. Schmidt.

Anaplasmosis in Cattle

Progress of this project will be reported from the Animal Disease Laboratory at Substation No. 3, Angleton, where the work is being carried on.

H. Schmidt.

Serum Calcium and Inorganic Phosphorus of Sheep

This project is being carried on at Substation No. 14, Sonora, and is reported upon at that point.

H. Schmidt.

The Role of Nicotinic Acid in the Nutrition of Ruminants

(In cooperation with School of Agriculture, A. & M. College of Texas.)

Another experiment has been completed with sheep in which the results corroborate in a general way those obtained previously. As indicated by results obtained with the sheep there seems to be no doubt that ruminants do not require an addition of nicotinic acid to their general food supply. The project has been revised so as to include herbivora in general and a series of observations were started with the horse as the experimental animal.

P. B. Pearson, H. Schmidt.

Testing Manufactured Feed Samples for Poisons or Other Harmful Substances

During the year nine samples of manufactured feed were submitted to this division for testing. All of the tests were negative.

H. Schmidt, F. D. Fuller.

Mastitis Investigations

(In cooperation with School of Agriculture, A. & M. College of Texas.)

The first year's work with mastitis investigation in the farm herd of the A. & M. College dairy has been concluded. The object was to find all latent

cases of mastitis, which were then treated with trypaflavin. In all, 20 quarters in 11 cows were treated of which three quarters remained negative, two others became positive again after having been negative for some time while the remainder were not influenced by the treatment. A change in the administration of the drug may give better results in the future. The work is being continued.

H. Schmidt, R. D. Turk, A. L. Darnell.

Investigation of Gastrointestinal Parasites in Cattle

Progress of this project will be reported from the Animal Disease Laboratory at Substation No. 3, Angleton, where the work is being carried on.

H. Schmidt.

Investigation of Toxemia in Cattle

Progress of this project will be reported from the Animal Disease Laboratory at Substation No. 3, Angleton, where the work is being carried on.

H. Schmidt.

Keratitis of Cattle

A project on keratitis of cattle has been approved during the year but it is too early to make a report on the same. Work on this project will be carried on at the Animal Disease Laboratory at Substation No. 3, Angleton.

H. Schmidt.

The Relationship of the "Gulf Coast Ear Tick," Amblyomma Maculatum, to Screw Worm Infestation in Livestock and Methods for Its Control

A project on the relationship of the Gulf Coast ear tick, *Amblyomma maculatum*, to screw worm infestation in livestock and methods for its control, has been approved during the year but it is too eary to make a report on the same. Work on this project will be carried on at the Animal Disease Laboratory at Substation No. 3, Angleton.

H. Schmidt.

CHEMISTRY

Factors of Soil Fertility

The results of pot experiments on differences in the availability of potash in different soils have been published in the proceedings of the Soil Science Society of America. Studies of the fixation of phosphates and the availability of soil phosphates and soil potash to plants have been continued. Methods for the determination of active phosphoric acid and active potash in soils high in lime are being studied.

G. S. Fraps and J. F. Fudge.

Soils

The results of chemical analyses of soils of Cass, Dickens, Falls, Hardeman, Polk, Scurry and Wheeler Counties were published in Bulletin 581. Similar work on soils of a number of other counties is being conducted. A paper on the effect of continued fertilization on the chemical composition of a Lake Charles clay loam at Angleton will appear in the Journal of the American Society of Agronomy. This work was done in cooperation with the Division of Agronomy.

G. S. Fraps and J. F. Fudge.

Nitrification

Calcium cyanamide in larger quantities than 100 parts per million of nitrogen depresses nitrification. Dicyandiamide and guanylurea, which are decomposition products of calcium cyanamide, also depress nitrification over a period of several months.

Plates of silica gels ranging from pH 5.20-9.00 are easily prepared and have been successfully used for the growth of autotrophic and heterotrophic organisms. If supplies of agar run low, this culture medium may become of especial importance.

In warmer sections of Texas, production of nitrates may take place every month of the year. There is no definite relation between the numbers of organisms and the different seasons of the year. In beaker cultures, high percentages of the soil nitrogen are nitrified in 12 months in some soils. The amount of insoluble nitrogen is about the same as before incubation, indicating the possibility of other sources of nitrogen than the soil. Puddling, when the moisture content is above 65 per cent of the water holding capacity, appears to be injurious to nitrification. Effect of vitamin B_1 on nitrification is being studied. The estimation of the nitrification capacity of Texas soils is being continued.

G. S. Fraps and A. J. Sterges.

Cotton Root Rot

Cultures of the cotton root rot organism tolerated over 100 parts per million of boron, though 200 parts per million reduced its growth. Iron salts stimulated its growth up to 100 parts per million of iron, and in larger quantities decreased growth. Selenium at 10 parts per million caused some decrease in growth. The pH and buffer capacity to pH 4.5 were determined on a number of soils for the Division of Plant Pathology and Physiology.

J. E. Simpson.

The Relation of Soil Composition to Plant and Animal Deficiencies

The study of the relation of the chemical composition of soils to plant and animal deficiencies has been continued. Particular attention was given to the phosphoric acid, protein, and lime contents of the forage. During the

year, about 1,800 forage samples and 75 soil samples were collected from locations in Northwest Texas, the Gulf Coast Prairie, and the East Texas Timber Country. Results of the analyses of 1,452 samples of forage and 80 samples of soil collected in the East Texas Timber Country have been published in Texas Bulletin 582. Similar publications for the Gulf Coast Prairie and for Northwest Texas are contemplated. Bulletin 586 deals with the composition of the range vegetation of Sutton and Edwards Counties and was prepared in cooperation with the Range Botanist. About 300 samples of various species of forage have been received from various Substations and Divisions of the Station for analysis in connection with studies of various factors affecting the chemical composition of forage. A study of fluorine in various Texas grasses, feeds, and salts is being carried on. Studies on the chlorine, sodium, and boron content of forage and soils are also in progress.

J. F. Fudge and G. S. Fraps.

Loco Weed and Other Poisonous Plants

Further separations and studies have been made on the fractions which have been found in previous work to contain the toxic principle of the loco weed. Two seperations have been made by adsorption on aluminum oxide. Other separations of the picrate have been made by adsorption. Further separation of the locoine solution has also been accomplished through benzoylation. On purification of the benzoylation products, there have been obtained a white crystalline, needle-like benzoate (m.p. 178-180°C); a petroleum-ether-soluble fraction yielding colorless crystals; and an ether-soluble, petroleum-ethel-insoluble, resinous benzoate. Determination of their absorption spectra were made on the various fractions. A study is now being carried on to learn which of these fractions contain the toxic material of the loco weed.

A substance, giving positive alkaloid tests, has already been obtained in crude form from Guajillo leaves. This substance is soluble in 95% ethyl alcohol, and in dilute acid solution, and is not removed from a dilute hydrochloric acid solution by either petroleum ether, chloroform, or ether. The work is being continued.

Productive Energy of Animal Feeds

A study of the metabolizable energy of chicken feeds has been published as Bulletin 589, in which methods for calculating the metabolizable energy from the digestible constituents are given. Work published in the Journal of Agricultural Research shows that the gains of energy of growing chickens are not necessarily in proportion to the gains in weight. A paper on the energy value of corn bran, rice bran, rice polish, and rye flour as measured by experiments on baby chicks has been published in the proceedings of the American Society for Animal Nutrition. Work on the productive energy of corn meal, alfalfa leaf meal, dried buttermilk, casein, cottonseed meal, and tankage as measured by gains of fat and flesh of growing chicks

is being prepared for publication. Another publication dealing with the productive energy of other feeds is being prepared and another on the results of over 400 digestion experiments with chickens.

Productive Energy of Human Foods

The productive energy of human foods is being studied by means of experiments with chickens, since many foods are used both by humans and by chickens. Experiments with rats are also being made, chiefly digestion experiments. The work on rats and chickens will be applied to human foods when the necessary preliminary work has been done.

Variations in the Vitamin Content of Human Foods

The relation of the chemical composition of butter fat to its vitamin A potency is discussed in a paper to appear in the Journal of the Association of Official Agricultural Chemists.

Differences in the value of carotene in different kinds of materials and of vitamin A as shown by amounts of vitamin A stored in the livers of rats are being studied. The loss of carotene from fresh vegetables, during preparation for analysis, and methods of determining carotene in fresh vegetables are discussed in a paper to appear in the Journal of the Association of Official Agricultural Chemists. Methods of determining carotene in tomatoes, watermelons and other foods in which lycopene occurs, have been presented in a paper published in the Journal of the Association of Official Agricultural Chemists. An article on the changes of vitamin C in turnip greens on boiling has been published in Food Research in cooperation with Dr. W. W. Floyd, Sam Houston State Teachers College, Huntsville, Texas.

A. R. Kemmerer, Ray Treichler and W. W. Meinke.

Quantitative Requirements of Animals for Vitamin A

The study of the quantitative requirements of chickens, beef and dairy cattle, pigs and sheep for vitamin A has been continued in cooperation with the Divisions of Poultry Husbandry, Dairy Husbandry, Range Animal Husbandry, Swine Husbandry, and Veterinary Science. The work with beef cattle is also in cooperation with the Bureau of Animal Industry, United States Department of Agriculture. Crude and pure carotene determinations were made at regular intervals on alfalfa or other feeds used in the work. Livers and blood plasma were analyzed for vitamin A and carotene. Further information on these studies will be given by various cooperating divisions. Bulletin 583, prepared in cooperation with the Division of Poultry Husbandry, deals with the vitamin requirements of chickens for carotene.

Methods for the determination of carotene and cryptoxanthin in yellow corn are being studied. In cooperation with Dr. P. C. Mangelsdorf of the

Division of Agronomy a number of samples of yellow corn of different genetic strains are being analyzed to determine the effect of inheritance on the quantity of carotinoid pigments.

Work on the purity and the effect of storage on several samples of commercial carotene is being prepared for publication.

Collaborative A. O. A. C. work for determination of riboflavin and of carotene was carried out. A bacteriological method and a fluorometric method for riboflavin in yeast and dried skim milk and the use of the photoelectric colorimeter under specified conditions for carotene in dried hays and grasses were adopted tentatively by the A. O. A. C. The reports on riboflavin and on carotene will be published in the Journal of the Association of Official Agricultural Chemists. Papers on an adsorption method for the determination of pure carotene, a report on riboflavin, and a paper on the estimation of units of vitamin D and vitamin A in fish liver oils and their concentrates have been published in the Journal of the Association of Official Agricultural Chemists. A paper on factors affecting the adsorptive power of magnesia for carotene has been published in Industrial and Engineering Chemistry, Analytical Edition.

A. R. Kemmerer.

Vitamins in Commercial Feeds

The vitamin D in 28 samples of fish oils or concentrates and the carotene in 30 samples of alfalfa products are published in Feed Control Bulletin No. 594. Methods for the determination of carotene and xanthophyll in yellow corn and mixed feeds containing yellow corn and methods for the determination of the carotene-destroying power of feeds are being studied.

G. S. Fraps and W. W. Meinke.

Iodine

Work on iodine in Texas was completed during the year, with the publication of the method used, and a presentation of the iodine analyses of drinking waters, vegetables, cottonseed meal, and roughages in Texas Bulletin 595. An article on the determination of iodine in soils, plant material and waters has been published in the Journal of the Association of Official Agricultural Chemists. Texas foods, feeds, and waters in nearly all cases contain sufficient iodine for humans and for animals, to that the general use of iodized table salt for human consumption or the use of iodized mineral mixtures for livestock are not to be recommended.

G. S. Fraps and J. F. Fudge.

Analyses and Investigations of Commercial Fertilizers

The Chief of the Division is State Chemist and is in charge of the fertilizer law. He is required to investigate the composition, properties and agricultural values of fertilizers and fertilizer materials or ingredients of fertilizers sold or offered for sale within the State of Texas.

One thousand and eighty-six samples of commercial fertilizers were collected and analyzed. In general, the composition was well up to that guaranteed by the manufacturers. The results of the inspection and analyses are published in Bulletin 593. Twenty-four samples were analyzed to check upon claims of non-acid-forming quality. Forty-eight samples representing the various grades of mixed and unmixed fertilizers were analyzed for lime and sulphur and a number for manganese. Investigations regarding the use of vitamin B_1 as an aid to plants are being conducted in the greenhouse. The fertilizer manufacturers agreed upon 25 grades of mixed fertilizers to be sold in Texas during the season 1940-41. A paper on the fertilizing value of spent phosphate catalyst has been published in the Journal of the American Society of Agronomy.

The report of the Chief as Referee on Fertilizers of the Association of Official Agricultural Chemists will be published in the Journal of the Association of Official Agricultural Chemists.

Greenhouse experiments studying the possible beneficial results from the use of pH 7.0 fertilizers on about 35 soils of low buffer capacity from the East Texas Timber Country showed no advantage for that class of fertilizers over the ordinary commercial fertilizers.

Greenhouse experiments studying the possible beneficial results from the use of vitamin B_1 for zinnias on a Lufkin fines sandy loam showed no advantages from the use of that compound. Further studies along that line are being conducted in cooperation with the College Greenhouse on snapdragons, pansies, cineraria, begonias, and Asparagus plumosa.

G. S. Fraps and T. L. Ogier.

Chemical Analyses and Investigations of Commercial Feeds

The estimation of protein, fat, water, crude fiber, and ash and the microscopic examination were made on about 3600 samples of feed for the Division of Feed Control. In addition, the hardness test was made on 27 samples of cottonseed cake, calcium carbonate was determined in 363 samples, salt was determined in 385 samples, and lime and phosphorus were determined in a number of mineral feeds. Twenty-eight samples of fish liver oils or concentrates were assayed for vitamins A and D and the carotene content determined in 30 feeds. These results are published in Bulletin 594 by the Division of Feed Control. Assistance was also given in the formulation of definitions and rulings. The determination of sodium in feeds is being studied.

G. S. Fraps and T. L. Ogier.

Mineral Composition of Vegetables Grown in Representative Regions of Texas and the Relation of Varieties in Mineral Content to the Probable Nutritive Value

This is a cooperative project with the Division of Rural Home Research and the Division of Horticulture. Work on methods of analysis for iron,

phosphorus, and calcium has been completed. Analyses for calcium, phosphorus, and iron have been made on about 100 sampes of turnip greens.

G. S. Fraps.

Miscellaneous

Analyses were made on a number of irrigation waters, mineral feeds and grasses, etc. A number of samples were analyzed in collaboration with other stations throughout the country and for various Divisions of the Station.

The accuracy of the chemical glassware, apparatus, and analytical weights used in the Division of Chemistry is tested before they are used.

Analyses of samples for ash, calcium, copper, sulphur, zinc, and basicity were made for referees of the A.O.A.C. in cooperative work on methods of analysis.

G. S. Fraps and T. L. Ogier.

HORTICULTURE

Fruit Adaptability Tests

Information on the varieties of peaches and other fruits less widely planted in Texas is accumulating from plantings at Substations No. 11 near Nacogdoches, No. 16 in the Wichita Valley and No. 19 in the Winter Garden as well as at the Main Station. Early varieties of peaches include Uneeda, a white-fleshed cling grown in the East. The fruit requires thinning and is too soft under East Texas conditions to ship well. It colors well. Golden Jubilee is attracting considerable attention because it is a good looking early yellow freestone peach. As grown in the test orchard at Nacogdoches there was a tendency for the blossom end to ripen prematurely, which would be expected to reduce its value for shipping. Halehaven is showing up well for the period immediately following Golden Jubilee. It is a firm yellow-fleshed freestone of good quality. Rochester, a comparatively old variety, has done fairly well at College Station and would seem to deserve more attention in this State, especially for roadside markets. Eclipse, another early yellow freestone, falls in the class of Rochester. Babcock is well suited for local market in South Texas, as it bears well after a mild winter. Brackett ripens just after Elberta. The tree is vigorous and inclined to over-load. Rio Oso Gem is also late. The tree is vigorous and reasonably productive. A seedling peach from James Schults of Killeen, Texas is a beautiful deep yellow cling. It ripens with Elberta. It is too soft to ship but its high quality should make it a welcome addition to any home orchard. Wilder's Early is a good early pear,

and Douglas and Garber are satisfactory later varieties for the Winter Garden. Tung oil trees were killed outright during January at Substation No. 2 near Tyler.

S. H. Yarnell, J. F. Rosborough, J. C. Ratsek, B. S. Pickett and Substation Superintendents.

Berry Breeding

Selections have been made of additional crosses involving the Nessberry to give a total of 48. These are being propagated for testing. They are characterized by early fruits of large size, by plant vigor and productiveness, and by relative freedom from defective fruits, a trouble that is becoming increasingly common in Texas. An account of crosses among commercial varieties is given in the report of Substation No. 11.

S. H. Yarnell, H. F. Morris.

Citrus

Adaptability and Breeding: Lake, Mineola and Thornton tangelos have been of high quality at the Lower Valley station this season. Two unnamed varieties 52018T2A and 52018K12G are especially desirable at the Winter Garden station. None of the tangelos ships well, although the last named shows some promise along this line as well as resistance to cold. The Owari, Silverhill, Ikiri and Yakushiji varieties of Satsuma oranges have done well at the latter point. A report on the behavior of the various types of citrus in the Lower Rio Grande Valley has been prepared for publication. A few citrange seedlings bore fruit at College Station. Additional orange crosses were made at Substation No. 15.

W. H. Friend, E. Mortensen, J. F. Wood, S. H. Yarnell.

Rootstocks: Wide differences in the amount of growth of the cion on different stocks was observed at the Winter Garden station. Work is also being done at Substation No. 15.

E. Mortensen, W. H. Friend.

Orchard Heating: Temperatures during January permitted work on this project at the Lower Valley station. It was found possible to raise the temperature within the grove five degrees by burning three quarts of fuel oil per hour, using an improvised heater at each tree.

J. F. Wood.

Cultural Studies with Grapefruit: Results secured in the Lower Rio Grande Valley using nitrogenous concentrates on citrus compare favorably with results from the use of complete fertilizers. The application of fertilizers and soil amendments in holes made with a crow bar has been found to be effective.

W. H. Friend.

Cytological Investigations: The following Citrus species and relatives have been found to have 18 somatic chromosomes: *Arancio bizzaria, C. aurantium, C. ichangensis, C. inodora, C. pectinifera, C. webberi, Eremocitrus glauca* and *Micromelum tephrocarpum.*

S. H. Yarnell.

Adaptability of Date Varieties

(In cooperation with the Bureau of Plant Industry, U. S. Department of Agriculture)

Early varieties ripened somewhat later in the Winter Garden this year because of fewer heat units. High humidity did some damage to fruit even of Hayany and Braim. Some seedling dates, however, escaped. At the Lower Valley station Halawy dates were successfully ripened off of the bunch in trays held for 5 days at 80° to 130°F.

E. Mortensen, J. F. Wood.

Figs

Adaptability and Breeding: Seedlings of several crosses bore fruit late in the season at College Station. Descriptions were obtained for selections. Undesirable seedlings will be eliminated at the end of the second fruiting season. Purple color in the fruit behaves as a dominant character as expected. Additional seedling material has fruited at Substation No. 3.

H. M. Reed, S. H. Yarnell.

Processing Experiments: For an account of this project turn to the report of Substation No. 3.

H. M. Reed.

Grapes

Adaptability and Breeding: One of the Gillett seedlings (TS25477) at the Winter Garden station is promising because of vigor and exceptionally good flavor. Highest yielding varieties at that station are Lenoir, Alicante Bouschet, Carignane, Chasselas Fontainbleau and Grenache. Most prolific varieties during their first season at the Fruit Investigations Laboratory in Montague county are Lenoir, Muench, Manito, Blondin, Beacon and Carman. There are now a total of 323 lots under test at the latter point. Leverkuhn, a new variety from the Houston area has done well on Lufkin fine sandy loam at the Main Station.

E. Mortensen, U. A. Randolph, S. H. Yarnell.

Rootstocks: In the rootstock test at the Winter Garden station heaviest yields were obtained from Lenoir on Dog Ridge, Black Malvoise on Champanel and Carignane on Dog Ridge roots. Satisfactory stocks, resistant to cotton root rot, have been found for all varieties but Tokay, Kurtelaska and Olivette de Cadanet. The rootstock planting at the Fruit Laboratory has been set in the field.

E. Mortensen, U. A. Randolph.

Cultural Tests: Reports on these tests are included with others of the Fruit Investigations Laboratory.

U. A. Randolph.

Processing Experiments: This work is being done by the Fruit Investigations Laboratory and Substation No. 3.

H. M. Reed, U. A. Randolph.

Papayas

Work on this crop including breeding and fruiting studies is being done at the Lower Valley station.

J. F. Wood.

Peaches

Breeding: The best seed parent in the peach crosses during the past season was Rochester, an early yellow freestone. This was crossed with Luttichau, an early white freestone of the Honey type. Several selections of A5, a cross between Pallas, an early Honey peach, and Hiley were "backcrossed" to the commercial early yellow freestone varieties. These were all made to secure early yellow freestone varieties with less drastic cold requirements for commercial planting in East Texas. A few fruits were obtained from other crosses made at Substations No. 11 and No. 16 and at the Main Station but not enough to make selections.

S. H. Yarnell, H. F. Morris, B. S. Pickett.

Cultural Tests: Work has been begun at Substation No. 16 on means of adding organic matter successfully to peach orchard soils.

B. S. Pickett.

Plums

Breeding: Most of the 1940 crosses were made on Burbank, Munson, Cumberland and Poole's Pride, using pollen of Abundance and Burbank. The object is to combine the adaptability and productiveness of the native forms with the size and quality of the Japanese plums. A total of 39 combinations involving around 4000 pollinations were made to study intercompatibilities. These latter gave 194 seeds, of which 124 set on Burbank. This variety set 21.5% of its pollinations in contrast to the 4.8% average set for all pollinations. No fruits resulted from selfing Abundance, Burbank, Cumberland and Milton. A total of 561 emasculated flowers of 6 varieties, left as checks, matured no fruit. About 25 trees from previous crosses are ready for orchard placement.

Pollen Studies: Pollen of 39 varieties was examined. Seventy-eight per cent of the pollen of 16 varietal selections of pure species appeared normal. This was 20 points higher than the average (58%) of 18 forms of hybrid derivation. Hybrids among different species of native or among different species of Japanese origin had pollen not much different in

viability from pure species derivatives. But hybrids between the two, with one exception, had pollen much inferior to the parental forms.

Pollen size within the different groups was, in general, quite constant. Pollen of *Prunus americana* and *P. mexicana* averaged about 25% longer and wider than that of *P. hortulana, P. munsoniana* and *P. angustifolia.* Varieties of the Japanese species *P. salicina* and *P. Simonii* had pollen grains of about the same size as the last group of native American plums. Pollen size of Green Gage *(P. domestica)* approached that of the larger-grained natives. Interspecific hybrids between American and Japanese species and among Japanese species have smaller pollen than the parental species.

Chromosome numbers: By means of the leaf smear technique 16 somatic chromosomes were found in Advance, America, Botan *(Prunus salicina),* Bruce, Cumberland *(P. hortulana),* Gold, Golden Beauty *(P. hortulana),* Simon *(P. Simonii),* Six Weeks, Surprise *(P. americana?),* Terrell, and Wild Goose *(P. munsoniana).* The varieties not followed by a scientific name are hybrids between *P. salicina* and various American species. Green Gage *(P. domestica)* is a hexaploid with 48 chromosomes. *P. caroliniana,* the native Cherry Laurel, is a tetraploid with 32 somatic chromosomes.

W. S. Flory.

Strawberries

Adaptability and Breeding: Highest yielding varieties at the Winter Garden Station during the past season were Ranger, Missionary, Rio Grande, Klondike and Alamo. Over a 5-year period Alamo had the highest yield (46% greater than Missionary). Eleven selections from the 1933 and 1934 crosses outyielded both Missionary and Klondike during this period. Four of these are of commercial quality. Ranger is rapidly increasing in popularity for commercial planting in the area. Female x perfect-flowered forms gave a 1:1 ratio for these flower types in the F_1.

E. Mortensen.

Culture: The proper handling of certain soils for successful strawberry growing is being studied at the Wichita Valley station (No. 16).

B. S. Pickett.

Truck Crop Adaptability Tests

In a varietal test for canning and quick freezing at the Lower Valley station Blue Lake snap beans gave by far the best yield. The test also included varieties of sweet corn and of lima beans. The Stokesdale tomato has done well both in the Lower Valley and Winter Garden areas. The new yellow sweet corns developed by the Texas Station made the best showing of any at Substation No. 19 in the Winter Garden. Additional information on varieties will be found in the reports of Substations Nos. 15, 16 and 19.

L. R. Hawthorn, W. H. Friend, J. F. Wood, B. S. Pickett.

Vegetable Variety Descriptions

(In cooperation with the Bureau of Plant Industry, U. S. Department of Agriculture)

The work on varieties of peppers and eggplant was continued at the Winter Garden station during the past season.

L. R. Hawthorn.

Cultural Experiments with Vegetables

Various cultural methods, including the use of fertilizers, soil amendments, green manures, and irrigation water are being studied under somewhat different circumstances at Substations No. 15 in the Lower Rio Grande Valley and No. 16 in the Wichita Valley.

W. H. Friend, B. S. Pickett.

Cabbage and Related Plants

Cabbage Breeding: Carrying cabbage selections from commercial regions through the summer in pots under lath has been found to be the most certain way of saving these plants for seed production at College Station. Early February selections sent to Wisconsin and also to Virginia failed to break dormancy and set seed in 1940. Selections from spring plantings at College Station are best carried through the summer in their original locations and then moved after the advent of fall rains. A number of additional selections from several varieties were made, and some previous selections were seeded, the aims being the same as outlined in preceding annual reports.

Results of cooperative investigations with J. C. Walker, University of Wisconsin in connection with this work were published as the following technical paper: "Effect of Different Environments on Head Shape in Marion Market Cabbage", Proc. Amer. Soc. Hort. Sci. Vol. 37, pp. 778-782.

Breeding Collards and Broccoli: Selections from inbred, and in some cases from commercial, lines were made. Most of these were individually selfed, but similar plants in three lines were isolated and massed. Several of the inbred collard lines appear more uniform, and more desirable in certain characteristics such as shorter petioles, than the commercial lines of Georgia Collards.

W. S. Flory, J. F. Wood.

Cabbage Variety Test: Varieties are under test both on the Lower Valley station and near Harlingen and Los Fresnos.

W. H. Friend, J. F. Wood.

Cabbage Fertilizers: The soils near Harlingen and Los Fresnos produce a better quality of cabbage without fertilizer, as applications of nitrogenous fertilizers make the heads coarse.

J. F. Wood.

Cantaloupe Breeding

A project has been started at Substation No. 15 in the Lower Rio Grande Valley to secure cantaloupes resistant to downy mildew. Material has been received from the United States Department of Agriculture and from the Florida Station.

J. F. Wood.

Onions

Breeding: This project is being extended at the Winter Garden station to include cooperative work with the Bureau of Plant Industry.

Cultural Investigations: Results of the fertilizer experiments at Eagle Pass, Laredo and Mineral Wells have been prepared for publication as a station bulletin. There are other tests at Substation No. 19 comparing the use of dry sets with green plants, and comparing different dates of planting and harvesting onions.

L. R. Hawthorn.

Pea Breeding

Selections of Thomas Laxton x Creole have been made which are about as early as Thomas Laxton. At the Main Station they produced 20 per cent more than the highest yielding Creole selections, and many times more than commercial Thomas Laxton. These selected hybrids, however, are too viny, and also they produce over too long a period for the canning types desired. Varieties of the dwarf, evenly maturing types are now being grown to be crossed with the hybrids involving Creole.

W. S. Flory.

Irish Potatoes

Variety Test: Chippewa is about two weeks earlier than Katahdin in the Lower Valley. Both are heavier producers and store better than Bliss Triumph.

Cultural Experiments: Additions of nitrogenous fertilizers did not increase yields in tests near Los Fresnos and Brownsville.

W. H. Friend, J. F. Wood.

Sweet Potatoes

Much of the work of the Sweet Potato Investigations Laboratory is in cooperation with the Bureau of Plant Industry, U. S. Department of Agriculture. It includes tests of seedling and varietal material and the effects of various cultural methods. A detailed report follows that of the Division.

R. E. Wright.

Tomatoes

Adaptability and Breeding: An early breeding selection was superior in yield to eight commercial varieties grown as a spring crop at College Station, but was less productive than Stokesdale grown as a fall crop at the Winter Garden station. This is being crossed with another selection having especially good color under high temperatures. A difference with respect to habit of growth has been observed in reciprocal crosses. The determinate variety, Bison, crossed with a breeding selection involving Kanora, Gulf State Market and a small-fruited type which is indeterminate gave an F_1, all plants of which were determinate. In the second generation certain families had larger plants than others and all were but a few entirely determinate. In the reciprocal both F_1 and F_2 were indeterminate. This situation is evidently due to factors in the breeding selection (No. 1102) since Bison x Summerset and reciprocal gave standard plants in the F_1 while in the F_2 there was a segregation approaching a 3:1 ratio, although the determinate class was smaller than expected. Summerset is being well received as a home garden variety that extends the harvest season and seed is now available commercially. Additional crosses and selections are being made at the Lower Valley Station.

S. H. Yarnell, L. R. Hawthorn, J. F. Wood.

Cultural Treatments: The work this season at the Lower Valley station was hampered by very unfavorable growing conditions. Pot experiments indicate some benefit from minor elements.

J. F. Wood.

Mineral Analysis of Turnip Greens

Seven Top turnips grown both at College Station and at Winter Haven for mineral analysis and other tests by the Divisions of Rural Home Research and Chemistry received applications of nitrogen, phosphoric acid, potash and calcium alone and in combination, on a factorial basis. At College Station applications including phosphoric acid gave the largest increase in yield. Nitrogen and potash in the fertilizer gave only a slight increase, while calcium depressed the yield. At Winter Haven the best combinations were NK, NCa and KCa.

S. H. Yarnell, L. R. Hawthorn.

Ornamentals

Adaptability: Progress Report 665 presents the results of tests of 414 species of ornamentals at the Main Station. Seeds of additional species including several Acacias and Albizzias have been received this season. A temperature of 8°F. at College Station killed a number of species of Crinum, Hippeastrum and Hymenocallis. Twenty additions were made to this group. An extensive report on the test at the Lower Valley station is in preparation. A planting of native materials is being made at the

Fruit Laboratory in Montague county. Many of the substation reports include information on their tests of ornamentals.

S. H. Yarnell, W. S. Flory, J. C. Ratsek, B. S. Pickett and Substation Superintendents.

Breeding Oleander and Privet: A number of cuttings from a hybrid of a red oleander crossed with a yellow double-flowered form showing greater cold resistance, were placed in the nursery in 1939 with seedlings of the same size from a red-flowered form. The cold of January froze the seedlings to the ground, but the hybrid cuttings were only killed to within about eighteen inches of the ground. This gave the hybrids a promising advantage in height and spread of bush throughout the season. Sixty pollinations of Dallas Privet seedlings by a lucidem type of Ligustrum gave 12 berries with a total of 15 seeds.

W. S. Flory.

Rose Breeding: Around 400 different combinations, involving some 6600 pollinations were made at Substation No. 2 this season. Of these 275 resulted in apparently good seed. Pollinations made when the humidity was above 75 per cent were apt to be unsuccessful. Seeds from the 1938 crosses continued to germinate. Several seedlings are under test as stocks.

J. C. Ratsek, S. H. Yarnell, W. S. Flory.

Examination of Rose Pollen and Chromosomes: Pollen of 63 forms of roses was examined. Of these, 20 were the same as last year. Only in the case of *Rosa canina* was the difference in apparent viability pronounced for the two seasons. Diploids tend to have better pollen than tetraploids and pentaploids, but the four hexaploids were equally divided between the two extremes, and the single octoploid had a high proportion of normal appearing pollen. With respect to normal pollen there is a narrower range among pentaploid than among diploid, tetraploid or hexaploid species. Somatic chromosome counts have been made of rose species carried under the following names at Substation No. 2: (diploid, 14) *Rosa acicularis Engelmanni, R. amblyotis, R. blanda, R. caudata, R. glauca, R. Giraldii, R. odorata, R. Roxburghii normalis;* (tetraploid, 28) *R. blanda, R. Harisonii, R. moschata grandiflora, R. oxyodon, R. recondita villosa, R. suffulta alba,* (pentaploid, 35) *R. mundi.* Two horticultural forms had the following numbers: the Iowa strain of *R. multiflora* 14, and I. X. L. 21.

W. S. Flory.

Rose Cytology: Counts of the somatic chromosome number have been made on forms received under the following names: (diploid) *Rosa bracteata, R. Giraldii, R. humilis, R. lucida alba, R. moschata alba, R. multiflora chenault, R. multiflora platyphylla, R. recondita, R. Roxburghii, R. Roxburghii hirsuta, R. rugosa alba, R. sempervirens, R. Soulieana, R. Watsoniana, R. Webbiana, R. Woodsii, R. xanthina allard;* (tetraploid) *R. alba, R. caudata, R. foetida bicolor, R. Harisonii, R. humilis, R. laxa, R. manetti, R. moschata floribunda, R. moschata grandiflora, R. nitida,*

R. oxyodon, R. palustris, R. recondita villosa, R. spinosissima altaica, R. suberecta, R. xanthina allard; (pentaploid) *R. Alberti, R. banksiopsis, R. gayiana, R. laxa, R. montivaga, R. morica, R. mundi;* (hexaploid) *R. hibernica, R. Macouni, R. mollis, R. montana.* Several of these have not previously been reported; others have only been observed in pollen material. In certain cases different plants of the same species have given different numbers in the polyploid series (diploid = 14). In some cases these counts do not agree with those already announced, which is understandable in view of the results just mentioned. Counts have been obtained of additional species that agree with previous reports.

S. H. Yarnell.

Cytology of Zephyranthes: Somatic numbers for the 3 Florida species *Zephyranthes atamosco, Z. treatiae.* and *Z. Simpsonii* are 24, 24, and 48 respectively. Several plants of *Z. longifolia* have 2n = 46. In *Z. pulchella* 2n = 48. An unidentified species of the genus from the Lower Rio Grande Valley has 47 somatic chromosomes plus 1 fragment. Two different numbers have been reported for *Z. candida;* in our material, as in that of Nagao and Takusagawa, 2n = 38. Approximate somatic numbers for *Z. microsiphon* and *Z. ajax* (said to be *Z. citrinia* x *Z. candida)* are 48 and 43 respectively.

W. S. Flory.

Propagation: Scions of the Live x Overcup Ness Hybrid Oaks were grafted on the following oak stocks: White, Burr, F_1 seedlings of Live x Swamp White, Live, F_2 seedlings of Live x Overcup, Black Jack, Chinese, Water and Swamp White. Where 10 or more grafts were made, Burr, Live, and Live Oak hybrid stocks were the most successful. The 2 grafts made on White Oak both survived. Of 22 cleft, 21 bark, and 119 whip grafts made on March 18 and 20, 6 (27%), 6 (29%) and 75 (63%), respectively, were surviving on September 11. Fifty-four per cent of the 162 grafts made were alive on that date. A few of the most vigorous grafts had attained a height of 5 feet by July 27. Distribution of these propagated oaks as source material for interested nurserymen is planned for the winter of 1941-42. Meanwhile additional scions will be grafted.

W. S. Flory, F. R. Brison.

Rose Investigations: These include studies of various cultural methods, rootstocks and the storage of bushes at Substation No. 2. Work on the effect of soil reaction on the behavior of roses is being done at Substation No. 6.

J. C. Ratsek.

SWEET POTATO INVESTIGATIONS LABORATORY

Gilmer

The Sweet Potato Investigations Laboratory is located in Upshur County, two miles south of Gilmer, on highway U. S. 271. The farm contains 117

acres, 85.4 acres being cultivated. Thirty-seven acres of the tract were made available for a five year period by the East Texas Yamboree.

The Laboratory was established in January 1938, and three years work has been completed. The principal problem with which the Laboratory is concerned is the average production of 75 bushels per acre for the State. The average yield from all experimental plats at Gilmer for the period 1938-40 was 210 bushels per acre. The need for a uniform strain of Porto Rico, the principal commercial variety, as previously reported is being met with the assistance of the cooperating agencies and the Laboratory. Because of more uniform quality, Texas sweet potatoes are now bringing a premium on the northern markets.

Fertilizer Test

Response to commercial fertilizer was more pronounced during 1940, due to the well distributed rainfall. The unfertilized check plat produced a total yield of 115 bushels, as compared with 330 bushels when fertilized with 600 pounds of 4-12-4. In the rate of application test yields increased constantly as the fertilizer was increased to 600 pounds per acre, coinciding with the results of the two previous seasons. Increasing the rate of application of each of the essential elements resulted in increased yields.

Time of Application of Fertilizer

Fertilizer at the rate of 600 pounds of 4-8-10 per acre was applied before planting, in split applications, and after planting to determine the most profitable time of application. A yield of 237 bushels per acre was recorded on the plots fertilized before planting as compared with 167 bushels when the fertilizer was all applied after planting. Plants grew off better when all the fertilizer was applied before planting.

Dates of Planting and Differential Spacings

This test was combined with a U. S. D. A. problem to include a wide range of spacings, dates of planting, and the Porto Rico and Triumph varieties. Close spacings (9 to 15 inches) resulted in higher yields than wide spacings (18 to 42 inches). Early planting resulted in higher total yields, whereas the percentage of marketable potatoes was highest in the late plantings. The average yield for seven spacings in five dates of planting was 257.0 bushels per acre for the Porto Rico, and 259.7 bushels for the Triumph.

Height of Beds

Five different height of ridges were used to determine the desired height for planting sweet potatoes. Little difference in yield and grade was noted from the various ridge heights this season, but a three year average indicates that a 6 to 9 inch ridge is most profitable.

Dates of Harvesting

This test indicates that sweet potatoes continue to make potatoes, with favorable weather conditions, until the vines are killed by frost. Market conditions will probably determine the time of harvest instead of the corresponding yield. Indications are that early harvested seed potatoes will produce earlier and more slips per bushel than those harvested after frost.

Size of Seed

Five sizes of Porto Rico potatoes were bedded to determine their respective value as seed stock. With favorable growing conditions little difference in yield was noted. The smallest seed potatoes produced the lowest percentage of U. S. No. 1 roots and the lowest total yield for the past three years. It is difficult, if not impossible, to eliminate off-colored roots from small seed potatoes.

Cover Crop Test

Sweet potatoes were planted following the second crop of oats, vetch and check plots, fertilized and unfertilized. Both oats and vetch plowed under ahead of sweet potatoes resulted in decreased yields. Vetch produced the heaviest tonnage of green manure and had the most depressing effect on subsequent yields of sweet potatoes. The check plot with commercial fertilizer produced the highest yield of sweet potatoes for each of the past two seasons.

Comparison of Rooted and Cut Slips

More plants were produced per bushel when cut from the bed than when pulled in the customary manner. The average yield for the last two years from the cut slips was 152.3 bushels per acre as compared with 132.0 bushels from the rooted slips. Cutting the slips also lessens the danger of carrying diseases from the plant bed to the field.

Variety Adaptability Studies

One hundred thirty-five lots of sweet potatoes, including standard varieties, promising seedlings, and selections were tested in replicated plots during 1940. Yields varied from 167 to 400 bushels per acre. The Porto Rico made a total yield of 194 bushels per acre as compared with 305 bushels for a selected strain of the same variety.

A wide range in the percentage of moisture was recorded in the different lots at the time of harvest, indicating a considerable variation in the starch content. Additional samples were taken from 98 lots on the day of harvesting, and will be analyzed for their starch content later in the season.

Small lots of 200 seedlings were grown for increase and for observation purposes. Two hundred additional seedlings were grown from true seed provided by the Louisiana Station, one of which produced a sweet potato weighing 39.5 pounds.

Approximately 150 different lots blossomed at the Laboratory this season, and 3000 true seed were harvested. This is the first time true sweet potato seed have been produced in the State, and the way is now open for a breeding program within the sweet potato growing area.

FRUIT INVESTIGATIONS LABORATORY

Montague

The Fruit Investigations Laboratory is located two and one-half miles southwest of Montague and nine miles northeast of Bowie, Montague County. Latitude is 33 degrees and 40 minutes north; longitude 97 degrees and 45 minutes west; and elevation approximately 1166 feet above sea level. The total rainfall for 1940 was 46.42 inches. This was unusually high while for 1939 the total of 24.52 was very low.

The Laboratory farm consists of 55 acres of land; 12.82 acres are planted in grapes, and 8.9 acres in tree fruits and berries. Most of the soil is typical of the fruit land in the northern portion of the West Cross Timbers.

The Laboratory was established in 1938 as the Grape Investigations Laboratory for the purpose of conducting investigations on problems of grape production, and to find ways of processing Texas grapes to find a ready market. Additional work was added to the Station in the fall of 1939 to conduct studies with tree fruits and berries, however, the chief concern remains with grapes. The first yield of grapes was produced during the 1940 season.

Grape Investigations

Variety Test: During the year, additional varieties were planted in the grape variety test. The collection to date includes 325 varieties, strains, hybrids, and species. Most of the varieties are of American origin. Eighty-nine varieties have come into bearing for the first time. Five varieties yielded more fruit than the leading commercial variety, Carman. The percentage yield of these varieties in comparison with the Carman for a single season are as follows: Lenoir 177, Muench 150, Manito 125, Blondin 113, and Beacon 109. Seven additional varieties made good showing in comparison with the Carman. These varieties with percentage rating are Extra 97, Edna 88, Longfellow 81, Catawba 80, Last Rose 76, Delicatessen 75, and Agawam 72. Lenoir, the highest yielding variety, averaged 6679 pounds on an acre basis. Carman varied in yield from 2759 to 5899 pounds per acre for the different plat locations. These represented differences in elevation, depth of soil and soil type. Fifty-two varieties, including Manito,

Extra, and Delicatessen, made more cane growth than the Carman. Dog Ridge produced the greatest amount of cane growth, making nearly five times as much as Carman.

Fertilizer Test: The object of this test is to study the fertilizer needs of grapes. Nitrogen failed to produce a comparable vine growth this season, when used in fertilizers containing phosphorus as it did the previous year. The smallest amount of wood pruned away from any combination of phosphorus fertilizers was 25 per cent higher than the nitrogen alone, or the nitrogen and potassium treatments, and more than twice the amount of the unfertilized plats. Plats treated with barnyard manure produced the largest amount of cane growth which was 66 per cent higher than the unfertilized plats. Increasing amounts of 6-12-6 from 300 to 900 pounds per acre, did not increase the amount of cane growth. Fruit yields varied from 1800 to 3866 pounds per acre with increases of from 0 to 900 pounds of 6-12-6. Plats receiving no phosphorus had lower yields then plats lacking either nitrogen or potash. Nitrogen increased the yield by 9 per cent as compared to no fertilizer, while the lowest yield of any treatment containing phosphorus was 43 per cent higher than the no fertilized plats. Plats given barnyard manure at the rate of 8 tons per acre yielded better than those receiving 6-12-6 at the 300-pound rate, although 600 pounds about equaled manure and 900 pounds was best of any treatment. There were also fewer clusters which were smaller in treatments with phosphorus absent. Largest clusters were produced by manure and the largest number by an application of 900 pounds of 6-12-6. The sugar content of the grapes was not affected by fertilization, except a slight decrease in the manured plats.

Pruning and Training Test: The single-trunk four-cane Kniffin and Munson systems of training the Carman grape were found to be about equally useful in the first year of fruit production. The Kniffin method produced 5053 pounds and the Munson 4835 pounds per acre. The latter system averaged one per cent more clusters, although the clusters on the Kniffin were 9 per cent larger. The Kniffin system resulted in an increase of 37 per cent or 1848 pounds per acre over the modified renewal system commonly used by many growers in the Montague area. Likewise, the number of clusters per vine were less and smaller in size with the modified renewal system. The weight of canes pruned away from the modified renewal was 18 per cent greater than the Kniffin and 38 per cent greater than the Munson. The trellis for the Munson system of training costs approximately one-third more to construct than the trellis for the Kniffin and the modified renewal systems.

Plantings with Reference to Terrace: Grapes planted on or near a terrace produced higher yield because of more and larger clusters than those planted between terraces. Vines above the terrace produced the largest fruit yield, although those on top of the terrace produced more vine growth. The fruit yield in pounds per acre for the first year in production were as follows: above terrace 5144, below terrace 4603, top of

terrace 4371, and between terraces 3165. The weight of wood pruned per acre varied from 1960 pounds from vines between the terraces to 4465 pounds from vines on top of the terrace.

Elevation and Soil Type Plantings: Most growers contend that grapes produce more and better quality fruit on the side of a hill. Plantings were made in 1938 to study the effect of location upon vine growth, yield, and quality of fruit. The locations consist of one planting on top of a hill, three plantings on the side of a hill, and one in the lowland. Apparently other factors have more influence on the production of vegetative growth and fruit yield than the elevation. Perhaps the depth of soil has some effect. For the first three seasons of growth, the vines located in the deepest soil, which was on the side of the hill, produced the largest amount of vine growth. Likewise, this planting gave the greatest yield of fruit for the first year in production. It produced 53 per cent more fruit and 104 per cent more cane growth than vines located in shallow soil on the hillside. The soil in the latter location is considered about average for the station vineyard and typical of the grape plantings of this area. Yields in pounds per acre were as follows: side of hill, deep sandy loam, 4879; lowland, 4632; side of hill, blow sand, 4450; top of hill, 3789; and side of hill, average soil, 3180. The fruit resulted in a slight decrease of sugar content with increasing amounts of vine growth. More new shoots were killed by late cold on the top and side of the hill than on low ground, probably due to the high wind.

Spacing Test: Spacings 8 by 12 and 10 by 12 feet produced 28 per cent greater yield than a spacing of 12 by 12 feet during the first year in production. However, the 12 by 12 foot spacing produced 31 and 20 per cent more cane growth than the 8 by 12 and 10 by 12 foot spacings, respectively.

Insect and Disease Control: The grape leafhoppers were very numerous in local vineyards during the 1940 season. Some of the varieties in the station vineyard were attacked by this insect in late summer. Calcium cyanide "A" dust applied under a tent was very effective in killing the leafhoppers. It is slow to apply and some burning of the foliage resulted. This material is very poisonous and should be handled with the greatest care. The operators used respirators in applying this dust. Treatments of Bordeaux mixture 4-4-50, sulphur dust, and wettable sulphur spray were used for control measures for black rot. There was no fruit infestation in this test block, however, some of the varieties were infested in other areas. Only two sprayings of Bordeaux mixture were applied. It was impossible to make a complete spray schedule because the spraying machine was received late in the season and because weather conditions were unfavorable.

Cover Crop Test: Three winter cover crops were grown in the vineyard. A very good cover was obtained by using a mixture of oats, wheat and barley. Hairy vetch also made a good growth, but not until late in the

spring. The Austrian winter peas were grazed by rabbits through the winter. A few plants came out in late spring and made fair growth. The cover crops may have depressed the growth and yield of grapes since the treatment without a cover crop made the largest amount of vine growth and fruit yield. All treatments received an application of 300 pounds of 6-12-6 per acre. However, as during the previous season when the crops did not produce a cover, the plats without a cover crop produced the largest amount of vine growth. These plats are possibly in the best soil locations.

Rootstock Test: Three of the leading commercial varieties, differing in vigor, grafted on a local species stock and also on Dog Ridge, Champanel, and La pryor stocks proven resistant to insects and diseases at the Winter Haven station, were set out for a vineyard test. The effect that the stock has on the production of vegetative growth and the yield and quality of fruit are the primary considerations. The Carman was selected as the vigorous variety, the Virginia as the one of medium vigor, and the Delaware as the weak variety. All stocks increased the cane growth of the Delaware from about 35 to 45 per cent, except Dog Ridge which gave a decrease. None of the stocks increased the growth of the Virginia, and only one. the La pryor, increased the growth of the Carman, which was by only 8 per cent.

Propagation Test: Over a period of two years, La Pryor used as a rootstock for Carman, Delaware and Virginia has given the highest per cent of successful graft unions. Carman and Delaware united best with La Pryor; Virginia united best with the local species. Dog Ridge gave the lowest per cent of unions. Grafts placed in a heeling trench and callused before planting gave a higher percentage of unions than those planted direct in the nursery. The test of treatments indicated that neither Hormodin "A" in 20 B. T. I. units nor Auxilin in .004 per cent concentration give root stimulation of grafts. Grafts with the tops of scions coated with paraffin gave the highest per cent of unions.

Callusing and non-callusing of cuttings had about equal effect on the number of rooted plants. Hormodin "A" in 40 B. T. I. units had the greatest effect on the rooting of cuttings (62.5 per cent rooting). Other treatments tried were Auxilin in .004 per cent concentration (56.7 per cent), Auxilin in .006 per cent concentration (53.3 per cent), tops of scions coated with paraffin (50.0), Hormodin "A" in 20 B. T. I. units (47.5), and no treatment (44.2 per cent). In general, with different methods of making cuttings, the nearest the cut was made to the top bud the greater the proportion of cuttings rooted.

Products Test: Ten lots of grape juice were bottled, totaling 111 gallons, and sent to the Angleton station for blending studies. Five of these varieties were secured from local growers of the Montague area because of limited quantity of fruit produced on the station. In addition, juice samples of fifty-two varieties were sent for analysis, and nine lots of fruit for other product studies.

Tree Fruit Investigations

Variety Test: A variety planting was made in 1940 consisting of three plants each of 45 varieties of peaches, 15 of plums, 8 of apples, 5 of pears, and 1 variety of apricot. The plants made excellent growth and only one pear tree failed to become established.

Cultural Test: Plantings of the Elberta peach were made during the past season for a test of fertilizers and cover crops. Neither nitrogen nor 6-12-6 increased the trunk growth during the first growing season.

Blackberry and Dewberry Varieties

Six of the common berry varieties were planted during the past season for a preliminary test on adaptability. They include Austin, Boysen, Dallas, Dew Black, McDonald and Young.

Ornamentals

Trees and Shrubs: The planting of trees and shrubs on the station grounds includes only species native to Texas. Only a few plants were added to the landscape during the past season because of construction work. The *Salvia regla* continued to attract much attention. It bloomed from mid-summer until frost producing an abundance of attractive light red flowers. *Berberis trifoliata* (Agrito), *Ilex vomitoria* (Yaupon), *Juniperus scopulorum,* and *virginiana* (Red Cedar) are proving to be hardy and attractive evergreens. *Leucophyllum texanum* (Cenizo) frozen to the ground, but came out in the spring and made good growth.

RANGE ANIMAL HUSBANDRY

Disease Resistance in Animals

(In cooperation with Division of Veterinary Science)

Observations have been continued at College Station on the preliminary selections made last year of sheep for resistance to the stomach worm, *Haemonchus contortus.* Of the original selected group of nine ewes in the flock at the end of 1939, eight are still living and in good health. These have been maintained continuously under conditions of intense natural exposure, without medicinal treatment, for over two years. Of seven ewes born in 1938 and 1939, added to the initial group, six are living and in good health. Two of the three ram lambs selected last year remain in good health. The third one, which is an F_1 Rambouillet x Mouflon *(Ovis musimon),* showed marked clinical symptoms of parasitism but recovered without treatment.

Three groups of lambs were maintained for purposes of selection and comparison under conditions of natural exposure without medicinal treatment. The first group consisted of nine lambs from parents showing

apparent resistance. The second group contained 16 lambs from non-selected parents. A third group of 16 non-selected lambs were each given doses of infective larvae ranging from 60,000 to 105,000 during the first week of life. The weather conditions in 1940 were extremely favorable for intense natural infection, and only one lamb from each of the groups survived. The purpose of the third group was to learn, if possible, whether the susceptible lambs could be eliminated during the first two months. However, of the six that survived the initial infection, five later succumbed to natural infection.

In June eighteen native and fifteen grade Cheviot ewes were added to the untreated selections. The mortality of the native ewes was 61 per cent and that of the Cheviots was 20 per cent during the six months period. The previously selected ewes had a mortality of 12.5 per cent for the entire year.

Work has been continued with *Nippostrongylus muris* and with the toxin of loin disease using mice, but no new findings are ready for report.

B. L. Warwick, R. D. Turk, H. Schmidt, R. O. Berry.

Cytological Studies in Sheep and Goats

From continued studies on the testicular material from young Rambouillet rams by use of the aceto-carmine technique, the chromosome number was established as 54. The morphology of these chromosomes is described in a manuscript which has been prepared for publication.

Preliminary observations on the chromosome complex of the Barbados sheep show that this breed is similar to the Rambouillet in chromosome number and morphology.

R. O. Berry, B. L. Warwick.

Inheritance of Polled Character in Fine-Wool Sheep

Four additional Rambouillet rams raised in the Station flock from polled breeding have been tested for homozygosity. One of these was found to be homozygous for the polled or hornless pair of genes. However, this ram carried the gene for cryptorchidism, which we had previously found to be segregating as a recessive. Additional rams are in process of breeding tests.

The study of polled and horned inheritance in Merinos, which is in cooperation with the Animal Husbandry Department, School of Agriculture, is being continued, but no new findings are ready for report.

B. L. Warwick, J. M. Jones, W. H. Dameron,
P. B. Dunkle, J. C. Miller.

Inheritance of the Ridgling Characteristic in Goats

Rigid selection was started in 1937 against the cryptorchid or "ridgling" defect of Angora goats in the Ranch Station stud flock. This has been

continued. The 1940 kid crop included ridglings by two of the six sires. This represents 4.8 per cent of the male progeny born in the flock and is still below the average of the flock for the 24 years the Station flock has been in existence.

Further testing of bucks from the Ranch Station has been made at the F. and B. Station by breeding them to "ridgling-bred" females and known mothers of ridglings, but none are yet known with certainty to be free from the recessive genes of both pairs which are concerned with this defect.

B. L. Warwick, W. H. Dameron, J. M. Jones.

The Inheritance of Fiber Characteristics in Rambouillet and Romney Sheep and Their Crosses

A small group of ¾ Rambouillet and ¼ Romney lambs has been raised and the matings are being repeated so as to insure enough males for adequate selection. Some segregation is already apparent.

B. L. Warwick, S. P. Davis.

Sheep Breeding for Blackland Area

The initial crosses have been made of Romney ram x Rambouillet ewes, and of Dorset ram x polled Rambouillet ewes (with depressions instead of knobs). For the first time, a group of Rambouillet ewes were bred so as to lamb in August and September 1940. A high proportion of them dropped lambs during these months and the lambs have made excellent growth during the fall months. The F_1 Romney x Rambouillet yearling ewes were also placed with one of the rams for early fall lambs, but none dropped fall or early winter lambs.

H. O. Hill, B. L. Warwick.

Transference of the Genes for Fineness of Fiber from Non-Angora to Angora Goats

(In coop. with Animal Husbandry Dept., A. & M. College)

Eight buck kids have been selected from the mating of a ¾ Angora buck to registered Angora females. If any of these ⅞ Angora bucks retain mohair fineness to adult age, as fine as that of either their sire or granddam, the best will be kept for one more back-cross generation before breeding *inter se*. In the meantime, the finest-fleeced F_1 buck (Angora sire x non-Angora dam) was bred to registered Angora females in the hope that a ¾ Angora male may be produced with even a finer adult fleece than that of the one which sired the kids born this year.

B. L. Warwick, S. P. Davis, J. C. Miller.

Interspecific and Intergeneric Hybridization with Sheep and Goats

Additional matings of F_1 Rambouillet x Mouflon *(Ovis musimon)* rams to Rambouillet ewes have been made. The offspring from these matings

show segregation for tail length ranging from that of the F_1 sire to the long tail of the Rambouillet parent. These offspring are also segregating for hairy and non-hairy coat covering. This appears to be due to one pair of genes, the allele for hairiness being dominant. Among this small group of only fourteen lambs, one male is non-hairy and has a tail corresponding in length and number of vertebrae to that of the F_1. This makes it practically certain that the genes for short tail can be transferred to high grade Rambouillets without those for the undesirable hairiness of the Mouflon.

B. L. Warwick, R. O. Berry, S. P. Davis.

Inheritance of Type in Angora Goats

Substation No. 14, Sonora

The purpose of this study is to develop information that may later be effectively used by Angora goat breeders in the improvement of their flocks. There has, for many years, been a divergence of opinion among breeders of Angora goats as to the several important characteristics which should be given most emphasis in a breeding program. One group of breeders have disregarded quality or fineness in mohair and have striven for pounds of mohair in too many instances at the sacrifice of quality. As a result, the general complaint by manufacturers of mohair materials is that our domestic mohair clip is lacking in quality. At the inception of this study, quality and weight of mohair, body development, and the elimination of kemp were important considerations in connection with the study of inheritance in Angora goats.

This investigation has thus far indicated that equally fine quality may be produced by flat lock and ringlet types; furthermore, that weight need not be sacrificed at the expense of average fineness. The average fleece weight per head (12 months growth, two shearings—fall 1939 and spring 1940—combined) produced by 164 registered Angora does, ranging in age from 1½ to 10 years, was 7.8 pounds, grease weight, while the average fleece weight per head produced by 69 doe kids for the same period was 4.7 pounds. In body weight, they ranged from 51 pounds for yearlings to 95 pounds for a heavy ten-year-old doe.

The grading of all the fleeces showed that the spring clip carried more pounds of the No. 1 and No. 2 grades than those shorn in the fall, thus indicating that the fleeces produced during the fall and winter period are finer in quality than those produced on lush ranges during the spring and summer.

J. M. Jones, B. L. Warwick, S. P. Davis, W. H. Dameron.

A Study of the Inheritance of Skin Folds on Rambouillet Sheep

(In cooperation with U. S. Dept. of Agriculture)

This investigation, which has been under way for a number of years, has as its principal objective the mode of inheritance of skinfolds on

Rambouillet sheep with a view of establishing a relatively smooth-bodied type of sheep of desirable conformation suited to the mutton trade and at the same time yielding a desirable quantity of fine-staple wool. In this study, Rambouillet sheep carrying heavy lateral neck skinfolds with medium to small skinfolds back of shoulders and on thigh, have been designated as B type sheep. Sheep with two to three large lateral neck folds under the neck but which do not extend prominently over the top, and devoid of skinfolds on shoulders or thigh, are recognized as heavy C type. Sheep with one to two medium-sized lateral skinfolds under the neck and devoid of body folds, are recognized as medium C type; while Rambouillet sheep which are free from lateral skinfolds under the neck as well as on the body are designated as light C type.

In 1940 the heavy C type Rambouillet aged ewes used in this study, which are grazed under range conditions on the Ranch Experiment Station, produced 9.25 pounds of wool, grease basis, with an average staple length of 2.23 inches; the medium C type ewes produced 8.6 pounds with a staple length averaging 2.39 inches; and the smooth-bodied or light C type produced 8.25 pounds with an average staple length of 2.58 inches. With the wool calculated on a clean or scoured basis, the fleeces produced by the heavy C type ewes shrank 60.9 per cent, and yielded 3.58 pounds clean wool; fleeces from the medium C type ewes shrank 58.2 per cent and yielded 3.6 pounds clean wool; and the fleeces from the light C type ewes shrank 56.9 per cent and yielded 3.57 pounds of clean wool.

There were no significant differences in the respective diameters of fiber for shoulder, side and thigh fleece samples between the respective types. In body weights, the heavy C type ewes averaged 111 pounds; the medium C type averaged 108 pounds; and the light C type averaged 111 pounds.

Besides the study of the types in the Rambouillet breed, study of F_2 animals of the Corriedale x Rambouillet cross have been continued. There is good evidence of segregation, but the study is not yet complete. The number of genes seems to be relatively small, which should make it possible to produce true breeding C and light C type animals.

J. M. Jones, B. L. Warwick, W. H. Dameron,
S. P. Davis, H. C. McPhee, D. A. Spencer.

Relation of Age of Animal to Fineness of Wool and Mohair

Diameter measurements of representative shoulder, side and thigh wool samples from Rambouillet ewes averaged 4.69, 4.66, and 5.18 one-ten-thousandth inch, respectively for first fleeces (52 averaged), as compared with 5.23, 5.04, and 5.67 one-ten-thousandth inch, respectively, for fleeces from aged ewes (188 averaged), thus confirming previous findings.

The data covering the wool phase of this study have been analyzed and should soon be available in manuscript form for publication as a Station bulletin.

J. M. Jones, B. L. Warwick, S. P. Davis, W. H. Dameron.

Vitamin A Requirements for Beef Cattle and Sheep

Substation No. 7, Spur, Texas

(In cooperation with Divisions of Chemistry and Veterinary Science, Texas Agricultural Experiment Station, and Bureau of Animal Industry, USDA)

In this trial, the sixth of a series, conducted for the purpose of determining the amount of carotene required for fattening beef cattle, heifer calves were used instead of steer calves. Forty calves of an average initial weight of 364 pounds were secured October 25, 1939. One group of 10 head, identified as Group 4, was started on 1000 mgms. of carotene per cwt. live weight daily supplied by dehydrated alfalfa leaf meal, and became depleted within an average of 113 days. The remainder, similarly fed on the basal diet composed of digester tankage, cottonseed meal, ground milo heads, and cottonseed hulls but not receiving additional carotene from alfalfa, became depleted in 98 days.

In the succeeding 100-day fattening period, Group 1 was supplied with 800 mgms. carotene per cwt. live weight daily; Group 2, 1000 mgms.; Group 3, 1500 mgms.; and Group 4 was continued on 1000 mgms. The respective average daily gains for the fattening period were 1.87 pounds, 1.80 pounds, 1.84 pounds, and 1.87 pounds. There was no significant difference in the gains. There was also no significant difference in night vision between the groups; in fact, all groups became completely night blind and the same number of convulsions (two in each) occurred for Groups 1 and 2. Slaughter and marketing data further revealed that the groups were remarkably alike in all respects.

Samples of liver were obtained at slaughter and samples of blood serum were secured at the start, at time of depletion, as evidenced by affected night vision, and at the close of the test for determination of carotene content by Division of Chemistry. At the start the samples averaged 0.59 PPM pure carotene, at depletion 0.16 PPM (0.31 PPM for Group 4), and at the close 0.19, 0.21, 0.34, and 0.27 PPM for the groups in respective order. The average pure carotene content of the liver samples were 0.47, 0.50, 0.72, and 0.65 PPM, respectively.

J. H. Jones, R. E. Dickson, J. M. Jones, J. K. Riggs.

Feeding Problems Affecting Beef Production

U. S. Experiment Station, Big Spring, Texas

(In cooperation with Bureau of Animal Industry, USDA)

Work has been continued on the study of the efficiency of grain utilization when (a) full fed, (b) 80% full fed, singly and in groups. Work was started to determine the effect of different levels and ratios of calcium, phosphorus, and magnesium on (a) the formation of urinary calculi, and (b) on gains and finish.

The occurrence of urinary calculi, which may cause a stoppage of the urethral tract and resulting loss of weight and possibly death unless relieved, is not a new problem and has not been unusual in sections where the rations for fattening steers, bulls, and wether lambs have consisted largely of the sorgo grains and roughages.

The results of a 182-day feeding trial in which 50 feeder steer calves were used, while not permitting conclusions, offer certain interesting information.

There was little evidence to indicate that the amounts and ratios of calcium, phosphorus, and magnesium which were fed had any effect upon the amount of urinary calculi found in the bladders. Instead, it appeared that the amount of fatness resulting from the full feeding of milo grain as compared to 80% full feeding of milo grain increased the amount of calculi found in the bladders.

The inclusion of large amounts of calcium, although apparently not affecting the amount of calculi found in the bladder, may, as indicated by body measurements, have increased bone growth and obviously had beneficial effect upon gains whether supplied by raw feeding bonemeal or pulverized oyster shell.

Exercise was apparently beneficial from the standpoint of lessening the occurrence of the calculi condition. There was no indication of benefit from exercise in regard to gain finish, and economy of gain.

The steers which were group fed had an advantage over the steers which were individually fed in gain, finish, and cost of feed per cwt. of gain.

The steers which were full fed grain had marked advantage over the steers fed 80% of the full fed grain ration in gain, finish, selling price, and financial return, but there was no difference in the cost of gain.

Part of the steers were fed cod liver oil of a commercial grade to supply 800 units of vitamin A potency per cwt. liveweight daily in addition to the basal ration of ground threshed milo, cottonseed meal, and red top silage. These steers, as well as the others which did not receive the vitamin A supplement, were almost completely night blind at the close of the 182-day feeding period.

J. M. Jones, F. E. Keating, W. H. Black,
Paul E. Howe, J. H. Jones.

Fattening Steers in the Madera Valley

Substation No. 9, Balmorhea, Texas

A group of 19 heifer and 31 steer calves (Hereford) were purchased in December 1939. The heifers were fed and marketed after 192 days while the steers still remain (1/1/41) at the Station.

The data concerning the heifers and steers represent a farm feeding operation rather than a feeding experiment, although a 72-day feeding period was involved in a comparison between chopped hegari fodder and chopped red top fodder in the feeding of the heifers. The lot of heifers fed hegari made slightly greater gain than the lot fed red top but the test period was too short for the results to be of much value.

J. J. Bayles, J. H. Jones.

Ground Alfalfa Hay, Alfalfa-Molasses Silage, and Ground Hegari Fodder, Cottonseed Meal, Cottonseed, and 28% Protein Whole Pressed Cottonseed Cake in Rations for Fattening Lambs

Substation No. 9, Balmorhea, Texas

An increase in the production of sheep and interest in lamb fattening in the Trans-Pecos prompted the inclusion of lamb feeding work in the livestock program of the Balmorhea Station.

Five lots (250 head) of good to choice Rambouillet wether lambs were used in an 84-day feeding trial.

The lambs fed either alfalfa silage or hay remained on feed better throughout the entire feeding experiment than the lambs fed ground hegari fodder as the roughage portion of the ration.

Alfalfa-molasses silage proved to be a useable and palatable roughage when fed with ground milo heads and 43% protein cottonseed meal; however, it apparently had no advantage over alfalfa hay fed under the same conditions. About 90 pounds of blackstrap molasses was used per ton of green alfalfa in the preparation of the alfalfa silage. The alfalfa silage was consumed in the ratio of 2.85 pounds of silage to 1 pound of cured alfalfa hay.

The results from feeding ground hegari fodder were not satisfactory but in other feeding tests lambs fed ground hegari fodder as the roughage portion of the ration have made good gains. The poor gains by the lots receiving ground hegari fodder lessened the value of the comparisons between cottonseed, cottonseed meal, and 28% protein whole pressed cottonseed cake. The lambs fed equal parts of ground milo heads and cottonseed made slightly greater gain than the lambs fed equal parts of ground milo heads and 28% protein whole pressed cottonseed cake. The group fed cottonseed, however, contained lambs with somewhat thinner flanks and backs than did the other groups.

J. H. Jones, J. J. Bayles.

Alfalfa vs. Sudan and Ground vs. Chopped Quadroon Heads in Fattening Lambs

Substation No. 16, Iowa Park, Texas

Four lots of 25 Rambouillet lambs were used in this, the second trial in comparing ground vs. chopped quadroon heads and alfalfa vs. sudan

hay. In each of two comparisons, the lots fed alfalfa hay made more gain and finished better than the lots fed sudan hay even though the sudan lots, receiving a supplement of pulverized limestone, were fed approximately twice as much cottonseed meal as the alfalfa lots.

The advantage for alfalfa was greater between the lots fed chopped heads than between the lots fed ground heads. The relative palatability of the rations is the most probable explanation of this difference, since the combination of chopped heads and sudan hay, which returned the least gain, was also the least palatable as shown by feed consumption.

Ground heads produced appreciably more gain and finish than chopped heads only when fed with sudan hay and this difference in results indicates that emphasis should be placed upon grinding when sudan is used as the roughage in lamb fattening rations.

J. H. Jones, L. E. Brooks, J. M. Jones.

Dried Citrus Peel and Pulp in Cattle Fattening Rations

Substation No. 1, Beeville, Texas

In a 154-day feeding trial (third test), it was more profitable to feed ground ear corn, shuck included, than to replace a portion of the corn with either 25 or 59 per cent of citrus feed when both of the two kinds of feeds were charged at the same price per ton.

All groups received the same amounts of cottonseed meal and good quality sorgo silage was fed according to appetite. The lot which received 59% of citrus feed and 41% of ear corn as the grain portion of the ration, consumed only 90% as much total concentrates as the check group, and 91% as much concentrates as the lot in which 25% of the ground ear corn was replaced by the dried citrus peel and pulp. This result agrees with previous work in indicating that a ration containing a large amount of citrus feed is less palatable than one consisting largely of ground ear corn.

The steers fed 100 per cent ground ear corn, and those fed 75 per cent ground ear corn and 25% citrus feed made practically equal gains and returned carcasses of almost identical grade, which results indicate that as much as 25% of ground ear corn may be replaced in the fattening ration with citrus feed provided feed prices permit of such substitution.

The average productive value of the dried citrus peel and pulp in the two comparisons available in this trial was 67.9 therms per 100 pounds feed as compared to a calculated productive value of 71.1 therms per 100 pounds for ground ear corn. The average productive value of the citrus feed for six comparisons in the three tests which have been completed has been 70.56 therms per 100 pounds.

J. M. Jones, R. A. Hall, E. M. Neal, J. H. Jones.

Utilization of Sudan Grazing and Various Supplements in Fattening Yearling Steers

Substation No. 1, Beeville, Texas

Forty good to choice grade Hereford steer calves were purchased in Bee County in the fall of 1939. Their subsequent development and sale as finished yearling steers in the fall of 1940 afforded a profitable market for a miscellany of farm feeds and provided useful information in regard to the utilization of sudan grazing with and without feed supplements of cottonseed cake, ground ear corn, and blackstrap molasses, respectively.

During a 156-day dry lot winter feeding period, the calves averaged 1.65 pounds daily gain on an average daily ration of 2 pounds of ground ear corn, 2 pounds cottonseed meal, 28 pounds grain sorghum silage, and 0.1 pound pulverized oyster shell; however, the gains made in the ensuing 140-day sudan grazing period, with or without feed supplements, were somewhat less.

Despite mediocre rate of gain, fleshy yearling steers of 750 pounds initial weight, when self-fed either cottonseed cake or ground ear corn, made good finish and were salable as slaughter steers at the close of a 140-day sudan grazing period. The carcases of steers marketed directly from sudan grazing and having been self-fed as above showed yellow color of external fat whereas similar steers, fed a balanced concentrate ration in dry lot, for a 56-day period following the period of sudan grazing, had much whiter fat.

Steers self-fed blackstrap molasses during the 140-day sudan grazing period consumed an average of only 2.57 pounds per head daily while other lots similarly self-fed consumed 6.69 pounds of cottonseed cake, and 12.26 pounds ground ear corn respectively.

Financial return did not favor the supply of a supplementary feed to yearling steers during the 1940 sudan grazing period because it was possible to produce a more desirable and a less expensive market finish in the subsequent 56-day dry lot finishing period.

J. H. Jones, R. A. Hall, E. M. Neal, J. M. Jones.

Beef Cattle Feeding Investigations Relating to Mineral Deficiency Studies in Range Beef-Cattle Production

(In cooperation with Divisions of Chemistry and Veterinary Science, and Bureau of Animal Industry, USDA)

(Falfurrias, Tex.)

The mineral deficiency investigations in range beef-cattle production were continued through 1940, this being the third year of the experiments. These studies continued to be cooperatively conducted by the Texas Agricultural Experiment Station, the Bureau of Animal Industry, USDA, and the King Ranch.

The treatments of the cattle in the experimental groups were continued as follows:

Group 1—No supplement.

Group 2—Raw feeding bonemeal to provide dry cows and yearling heifers with 6.5 gms. phosphorus and approximately 13 gms. calcium, and the lactating cows with 14.3 gms. phosphorus and approximately 28.5 gms. calcium.

Group 3—Di-sodium phosphate to provide the dry cows and yearling heifers with 6.5 gms. phosphorus and the lactating cows with 14.3 gms. phosphorus.

Group 4—Raw feeding bonemeal to provide all cows and yearling heifers with 6.5 gms. phosphorus and approximately 13 gms. calcium plus mineral salts to provide 160 mgms. iron, 100 mgms. manganese, and 15 mgms. each of copper, cobalt, boron, and zinc.

Percentage calf crops produced per group were as follows: Group 1, 41%, Group 2, 61%, Group 3, 78%, and Group 4, 82%. Average pounds of calf produced per cow at the end of the year, pro rated to all cows in the groups, were as follows: Group 1, 164.1, Group 2, 300.4, Group 3, 357.8, and Group 4, 390.9. The lactating cows in Group 1 became more emaciated than similar cows in the mineral-fed groups, but this group of cows as a whole, due to the small calf crop, made larger gains than the cows of the other groups.

The average gains made by the yearling heifers from weaning to the end of the year were as follows: Group 1, 235.6 pounds, Group 2, 262.5 pounds, Group 3, 266.6 pounds, and Group 4, 279.6 pounds.

The inorganic phosphorus content of the blood of the lactating cows of Group 1 was below normal in nearly all instances. The level of this element in the blood of the lactating cows of the mineral-fed groups remained practically the same as that of the dry cows of these groups. The inorganic phosphorus content of the blood of the yearling heifers of Group 1, while seldom being extremely deficient, was consistently lower than that of the blood of the yearling heifers in the mineral-fed groups. There continued to be no consistent differences in the hemoglobin content of the blood of the cattle of any of the experimental groups. There were also no consistent differences in the inorganic phosphorus content of the blood of calves from cows in Group 1 and that of calves from cows in the other groups.

Grazing conditions were adverse during practically all of the year. Rainfall in the experimental pastures was not adequate to promote a sufficient growth of grass that any surplus forage could be accumulated. It was necessary therefore for the cattle to subsist on vegetation that was certainly inadequate in quantity although its phosphorus content was somewhat higher than in previous years due to practically all of it being new growth.

L. H. Tash, J. M. Jones, W. H. Black, Paul E. Howe, J. H. Jones.

Mineral and Protein Deficiencies in the East Texas Forest Region

East Texas Pasture Investigations Station, Lufkin, Texas

The comparison between feeding bonemeal and TVA dicalcium phosphate as sources for the supply of phosphorus in self-fed salt lick mixtures was continued for the second year and was completed October 29, 1940. The mixtures used were (a) 1 part salt and 2 parts feeding bonemeal, and (b) 3 parts salt and 1 part TVA dicalcium phosphate.

Lot 1 (10 mature Hereford cows), which received bonemeal, averaged 1195 pounds November 1, 1939, and 1231 pounds October 29, 1940. The respective weights for a similar group, Lot 2 (9 mature Hereford cows), were 1159 pounds November 1, 1939, and 1262 pounds October 29, 1940. Lot 1 consumed an average of 0.81 ounces of kiln dried salt and 1.62 ounces of feeding bonemeal per head daily during the 364 day period. Lot 2 consumed an average of only 0.41 ounces of salt and 0.135 ounces of dicalcium phosphate.

Marked differences obtained in the seasonal consumption of the mineral mixture. Much larger amounts of the mixtures were consumed when the cows were losing weight and were short of pasturage than when they were gaining in weight and had abundant pasturage.

A repetition of low percentage calf crop (70%) and the failure of the Hereford bull owned by the Station to settle the cows during the breeding season has indicated that a breeding problem exists. With the failure of the Station-owned bull, a three-year-old Brahman bull was used during the late 1940 breeding season.

J. H. Jones, E. K. Crouch, J. M. Jones.

Dehydrated Sweet Potato vs. Ground Shelled Corn for Fattening Beef Calves

(In cooperation with Animal Husbandry Dept., A. & M.C.)

Dehydrated sweet potato (no starch removed) is being compared with ground shelled corn in rations of fattening calves in a test started November 8, 1940 to determine its palatability and feeding or productive value as a carbohydrate replacement for corn in cattle fattening rations. Three lots of medium to good heifer beef calves will be fed during a 112-140 day period on the following feeds:

Lot 1: check, ground shelled corn, 43% protein cottonseed meal, prairie and alfalfa hay.

Lot 2: dehydrated sweet potato as a full replacement for corn with other portions of ration similar as fed in check group.

Lot 3: Equal parts ground shelled corn and dehydrated sweet potato meal, with cottonseed meal and prairie and alfalfa hay as in Lot 1.

N. G. Schuessler, J. M. Jones.

Fattening Angora Wethers in Dry Lot

(In cooperation with Animal Husbandry Dept., A. & M. C., and Division of Rural Home Research, TAES)

Angora wethers, one, two and three years old, are being compared with Rambouillet lambs in a 100-day fattening test started October 16, 1940 to determine (a) relative feed consumption, (b) rates of gain, (c) feed requirements per 100 pounds of gain, and (d) the quality of the meat produced as compared with that of lamb.

The initial weights of the respective groups were as follows: Lot 1, lambs, 61 pounds; Lot 2, yearling Angora goats, 51 pounds; Lot 3, two-year-old Angora goats, 63 pounds; and Lot 4, three-year-old Angora goats, 77 pounds. The respective groups are being full fed on a mixture of whole shelled corn and 43% protein cottonseed meal (ratio 9:1) and alfalfa hay.

J. C. Miller, J. M. Jones, N. G. Schuessler.

Determining Grades and Shrinkages of Texas Wool

As has been stated in previous reports, this Division has, since 1921, encouraged Texas sheep breeders to submit representative samples of their respective clips for grading and scouring at the A. and M. College Research Wool Scouring Plant. It is believed that such a procedure will not only impart accurate information with reference to grades and shrinkages of the respective wool clips, but that it will also give wool growers a definite basis for the further improvement of their wools.

At the time of the establishment of the A. and M. College Research Wool Scouring Plant in 1919, Texas wool production totaled approximately fifteen million pounds annually. By 1940, the production of wool had increased to around 80 million pounds. It is obvious, therefore, that the original plant, with a maximum daily capacity of 250 pounds unscoured wool, was not adequate to render prompt service to a representative number of Texas wool growers. To remedy the situation, the last legislature (1939) made available an appropriation of $9,353.00 for the enlargement of the plant.

During the year, the wool scouring plant was removed to the Old Textile Engineering Building and with the enlarged facilities the plant is now estimated to have a maximum daily capacity of about 2,000 pounds of wool, grease basis.

Installation of the new wool scouring equipment, which now includes a four-bowl scouring train, was not completed until late in the summer of

1940. This limited the amount of wool graded and scoured to 26,369 pounds, grease basis, which showed an average shrinkage of 61.7 per cent.

The study, "Accuracy of Small Wool Samples for Shrinkage Tests", has necessarily remained inactive during the year on account of lack of scouring facilities while the new equipment was being installed. It is planned to resume this investigation during the next year.

S. P. Davis, J. M. Jones, B. L. Warwick.

ENTOMOLOGY

Biology, Control, and Taxonomy of White Grubs, *(Phyllophaga* spp.) in Texas

About 2000 white grubs were isolated for detailed developmental records during the year. Approximately one-third of these individuals were reared to maturity, and the complete life cycle of three allied forms *(Phyllophaga tristis tristis; P. tristis apicata; P. tristis amplicornis)* was established as follows: egg stage 26 days; larval stage 126 days, and pupal stage 22 days. Practically all of the remaining grubs *(Phyllophaga crassissima; P. rubiginosa; P. farcta; P. pleroma)* attained the final larval instar and are passing the winter as full grown larvae.

High mortality occurred among the grubs carried over from the previous season and the data are not sufficient for definite conclusions regarding the life history of any species requiring two or more years for completion of the life cycle. The rearing records so far secured indicate that *Phyllophaga crassissima, P. bipartita, P. calceata,* and *P. rubricosa* are normally two-year cycle species, but they sometimes complete development in one year; this is especially true in case of *crassissima,* which is an economically important widespread species. Present records indicate that *Phyllophaga profunda, P. arkansana, P. praetermissa, P. cribrosa, P. rubiginosa,* and *P. submucida* regularly require two years to complete their life cycle.

Analytical keys to the species of May beetles occurring in Texas have been nearly completed. This is an essential part of the taxonomic studies conducted under the project. Distributional records secured during the year have considerably extended the known range of several species. The life history data completed during the year, for all forms of *P. tristis* indicated above, have been analyzed and prepared for publication.

H. J. Reinhard.

Boll Weevil

(In cooperation with the Bureau of Entomology and Plant Quarantine, U. S. D. A.)

The low winter temperatures were effective in greatly reducing the percentage survival of weevils, but favorable weather conditions in spring for longevity of weevils enabled them to overcome the handicap of a small survival and cause considerable damage to late summer and early fall cotton.

F. L. Thomas.

Control: In experiments this year commercial calcium arsenate and a special calcium arsenate containing large particles and a high percentage water-soluble arsenic pentoxide were equally effective in reducing the weevil infestation. Commercial calcium arsenate was more effective against weevils than either synthetic cryolite-sulphur (85-15) or natural cryolite-sulphur (85-15).

J. C. Gaines.

Eleven applications of calcium arsenate and three of nicotine sulphate-lime were made on this experiment from June 22 to August 15 to control weevils and aphids. Calcium arsenate effectively controlled the weevils and increased the aphid population. This reduction in weevil infestation caused a significant increase of 394 pounds seed cotton per acre. Nicotine sulphate-lime reduced the aphid population but did not significantly increase the yields. Records of aphid populations were made in all control experiments, and it was found that the arsenicals containing the highest percentage water-soluble arsenic pentoxide contributed to higher increases in aphid populations than other materials such as cryolites. More than seven applications of arsenicals were made at College Station before aphids increased to numbers considered injurious, while ten applications of calcium arsenate at Port Lavaca failed to increase the aphid population to injurious numbers.

J. C. Gaines and S. E. Jones.

Arsenical sprays were compared with the calcium arsenate dust treatment for boll weevil control. Lead and calcium arsenate were applied as sprays at 4 and 7 pounds per acre respectively. These treatments were compared with calcium arsenate dust applications at 5 to 7 pounds per acre. The sprayed plats yielded 78 to 80 pounds more seed cotton per acre than the untreated plats as compared with increases of 203 and 366 pounds on the dusted plats.

W. L. Owen, Jr.

Hibernation: Survival data were taken at College Station on ten lots of 500 boll weevils each installed in separate cages at weekly intervals from October 7 to November 18. The hibernation cages were situated under open-field conditions and Spanish moss was provided as shelter

material. Removal of active weevils from the cages was begun on April 8, 1940, or about one week after young cotton was up in local fields.

The dormant season temperatures encountered by the hibernating weevils were below normal and followed by a heavy mortality of the insect. The minimum temperature was 8°F. In fact, only 2 individuals, or .04 per cent of the 5000 installed passed the winter successfully. For the period 1936 to 1940, inclusive, the average boll weevil survival is 5.02 per cent.

H. J. Reinhard.

Cotton Flea Hopper

(In Cooperation with the Bureau of Entomology and Plant Quarantine, U. S. D. A.)

The cotton flea hopper emergence in 1940 varied greatly. Hatching from caged weeds indicated an average population present, but field observations showed that only small numbers were threatening cotton. Horsemint was well loaded only in the northern half of the State, and this fact may account for the sudden midsummer rise in the infestation of cotton in North Texas which, however, quickly subsided in most areas. Very little damage occurred.

R. K. Fletcher, J. C. Gaines, F. L. Thomas.

Migration and Dispersal: The number of adult flea hoppers taken on the screen traps during 1940 was low. The first hopper was captured on a trap located in a weed field on April 2 and in cotton fields on April 9. The peak of transfer from weeds to cotton occurred during the first two weeks of May. Cotton was planted later, and the transfer began earlier in 1940 than in 1939.

Flea Hopper Abundance: A low spring emergence was recorded in the spring of 1940. During the fall of 1940, the hopper population had reached a peak of only 745 insects per 100 sweeps during the first week in September and decreased in a three week period to an average of 108 adults per 100 sweeps. This is one of the lowest fall population records indicating a lower emergence for the spring of 1941 than in 1940.

J. C. Gaines.

Host Plant Studies: The horsemints, *Monarda* spp., are among the favorite host plants of the flea hopper. Very large populations develop at times on the flower clusters of this plant. When the horsemint matures, the adult flea hoppers leave and find their way to other host plants including cotton. In a survey made during April, May, and June of 1940, it was found that the approximate dates of maturity were as follows. The average number of adult flea hoppers per 100 sweeps follows the date in parenthesis. DeWitt County, May 15 (85); Bastrop County, May 20 (123); Brazos and Burleson Counties, June 7 (810); Milam County, June 7 (758); Falls and Limestone Counties, June 15 (672). An average of 2800 adult flea hoppers and 1400 nymphs per 100 sweeps were found in one field of horsemint in the Brazos River bottoms.

Studies of the distribution and abundance of croton, the preferred overwintering host plant of the flea hopper were continued. In a survey which included the following counties—Brazos, Burleson, Milam, Robertson, Limestone, Freestone, Leon, Madison, Grimes, Lavaca, DeWitt, Bastrop, and Lee, and covered 613 miles of highway—68.6 miles of fields bordering the highways had croton thick enough to make accurate sweeping records.

In studies made in Brazos and Robertson counties of the effect of land use on the abundance of croton, the following records were taken on the number of crotons per acre. Ungrazed grass fields 524; pasture (tight soil) 3941; pasture (sandy soil) 49,245; fallow one year 39,204; fallow two years (ungrazed) 537; following oats 38,188; following corn the same season 7712; following cotton same season 1788; new terraces 8276. The above records include 56 fields.

In general, the above records show that croton weeds were more abundant in the fall of 1940 than in the fall of 1939 in the same fields. The much greater abundance of croton in sandy pastures is shown. The highest croton counts per acre were found in sandy soils where sheep and goats were pastured. It is suggested that the disturbance of the soil by the hoofs of these animals may account for part of this abundance of croton in such soils.

R. K. Fletcher.

In North Texas the first nymphs were taken on miscellaneous weeds April 15, and in this location adults were found by the middle of May. In other fields where no nymphs were found, adults were recorded as early as April 30 and indicate that some field infestations occur as a result of the dispersal of adult hoppers.

W. L. Owen, Jr.

Varietal Resistance: These studies again were conducted at the four locations—College Station, Port Lavaca, Terrell, and Waco. Again the early and late maturing varieties had higher flea hopper infestations than the intermediate varieties. The early maturing variety produced the most cotton in spite of the higher hopper infestation. Low non-injurious infestations of hoppers occurred at College Station, Terrell, and Waco, while at Port Lavaca a gain of 173 pounds seed cotton per acre was produced from applications of sulphur on the early maturing variety. Applications of calcium arsenate reduced a severe bollworm infestation at College Station, and a gain of over 400 pounds of seed cotton per acre was produced on one of the intermediate varieties. The highest bollworm injury was recorded in the earliest and latest maturing varieties. The work is to be continued.

J. C. Gaines, S. E. Jones, W. L. Owen, Jr., F. L. Thomas.

Relation of Rotations, Spacing, and Fertilizers on Infestation: The hopper infestation was low in all plats and little difference was recorded between the infestation in cotton which had been fertilized with barnyard

manure and that which was unfertilized. A slightly heavier infestation was found in normal spaced cotton as compared with the wide spaced cotton. Little difference was recorded in the infestation found in cotton fields following alfalfa or clover. The average number of hoppers per 100 plants in 11 fields following cotton was 22; on six fields following corn 21; on six fields following oats 26; on two fields following cowpeas 16; and on one field following no crop 26. Infestation on cotton following oats and no crop, both practices leaving the land idle most of the previous season, showed about the same infestation. Again succulence of plants seemed to determine abundance of the insect.

Influence of Method of Planting upon Infestation: With light infestations practically no difference in the numbers of flea hoppers were recorded in fields where two rows were planted to cotton and the third left idle, and in adjacent fields where every row was planted to cotton. In two cases infestation was slightly lower where the third row was left idle, but in the third case the opposite was true. Succulence of plants seemed to be the determining factor affecting the infestations.

J. C. Gaines, W. L. Owen, Jr., and F. L. Thomas.

Hibernation: To secure records on the emergence of young flea hoppers in the spring 12 lots of 100 *C. capitatus* plants each were collected in Brazos, Grimes, Leon, Robertson, Madison, Milam, Burleson, and Washington Counties after the occurrence of killing frost, and placed in separate emergence cages on February 29, 1940. The overwintering eggs began to hatch on March 11 as compared with February 27 during the previous season. The seasonal accumulative emergence recorded at biweekly intervals was as follows: March 1-15, 0.05 per cent; March 16-31, 0.41 per cent; April 1-15, 39.83 per cent; April 16-30, 81.21 per cent; May 1-15, 99.08 per cent; May 16-31, 99.98 per cent. Last emergence totaled 4115 flea hoppers per 100 *C. capitatus* plants; this figure approximates the average recorded during the period 1926 to 1937, inclusive. It is considered too low to cause injurious early infestations in cotton.

H. J. Reinhard.

Hatching or emergence at Terrell from weeds collected in Dallas, Hunt, Kaufman, and Van Zandt counties in North Texas began March 22 as compared with March 20 in 1939 and March 14 in 1938. The peak of emergence took place during the second week in April, and by the end of the month 94 per cent had emerged.

W. L. Owen, Jr.

Control: Comparisons of ground sulphur, sulphur of microscopic fineness, and a ground sulphur-calcium arsenate mixture were made in a series of tests, but no differences were found between the effectiveness of these materials under the conditions of a low hopper infestation.

J. C. Gaines.

A comparison of ground dusting sulphur with sulphur of microscopic fineness in spray form showed that the sulphur dust was more effective in reducing the hopper infestation than the sulphur spray.

W. L. Owen, Jr.

Tests were continued at Port Lavaca to determine the merits of early dusting to control flea hoppers on land infested with cotton root rot *(Phymatotrichum omnivorum)*. Due to the low flea hopper infestations throughout the season practically no injury occurred and control measures were not necessary.

S. E. Jones.

Pink Bollworm

(In cooperation with the Bureau of Entomology and Plant Quarantine, U. S. D. A.)

The pink bollworm infestation in the Big Bend area was lighter than at any time within the past several years. A light worm carryover combined with seasonal factors that brought about an early maturity of the crop was responsible for the low intensity of the infestation.

In the cultural control experiments the planting of quick maturing eastern varieties of cotton developed for boll weevil conditions combined with close spacing, and withholding of late seasonal irrigations produced less than one-third as many worms during the season as the slow maturing variety generally used in the irrigated section of the Southwest. Of the various winter cultural practices for reducing the survival of hibernating larvae, deep plowing early in the winter followed by irrigations again gave the best control.

Although the investigations on control of the pink bollworm with insecticides were handicapped by a low infestation, certain trends were apparent in the field tests. In a randomized block arrangement, basic copper arsenate and cuprous cyanide dusts were less effective than Cryolite dust or Cryolite-oil spray. In a Latin square test comparing Cryolite dust composed of three particle sizes the materials with micronized and regular size particles were more effective than the material with coarse particles. Petroleum oil and nicotine sulphate were tested in the laboratory as an ovicide. Both materials reduced the percentage of eggs hatching; however. they were more effective when combined.

Rearing of introduced parasites of the pink bollworm was continued, and the adults were released in the Presidio Valley and the Lower Rio Grande Valley as follows: *Chelonus blackburni* Cameron, 186,000; *Microbracon kirkpatricki* Wilk, 20,699; *Microbracon nigrorufum* Cushman, 3,400. Rearing of *M. kirkpatricki* was previously discontinued (1937), but was resumed since it was thought that conditions in the Lower Valley were more favorable for its establishment. Recoveries were made showing initial establishment of all three species, but only *M. kirkpatricki* was

found not to hibernate in the immature stage in hibernation cages. This year's releases of this species were reared from new stock received from Egypt through cooperation with the Division of Foreign Parasite Introduction. Two new species were received this year, *Chelonus pectinophorae* from Japan and *Calliephialtes dimorphus* from Brazil, but the stocks did not build up sufficiently for liberation.

Field observations were made in the Lower Rio Grande Valley to determine how and where the pink bollworm passes the winter in that area. Larvae were found in green fruiting forms of cotton until all of the cotton was killed about the middle of January 1940, and again when blooms became available in May. There seems little doubt that breeding will continue throughout the winter if normal conditions prevail and food is available. Resting larvae were found in old bolls, and locks of cotton on plants and on the soil surface or buried in the soil throughout the winter and until April 1940. Seasonal observations on the pink bollworm build-up during the growing season showed that there was a very light infestation in blooms during May and June; however, worms were quite numerous in bolls in a few fields at the close of the season. About 50 species of Malvaceous plants occur in the Lower Valley. Infestation has been found in *Malvaviscus drummondii.* and *Wissadula* sp. besides in cotton and okra. During the fall of 1940 large quantities of the fruiting forms of *Malvaviscus drummondii* and *Wissadula* sp. were collected and placed in emergence cages. Fifty-six pink bollworm moths emerged from the cages containing *Malvaviscus drummondii* and two moths from the cages containing *Wissadula* sp.

A. J. Chapman, et al.

Cotton Bollworm

(In cooperation with the Bureau of Entomology and Plant Quarantine, U. S. D. A.)

Biological: The maximum emergence of *Heliothis armigera* from corn ears occurred the second week in June in the southern part of De Witt County, the third week in June in Fayette County, the fourth week in June in Brazos and Burleson Counties, the first week in July in Falls County, and the second week in July in Limestone County. There was, however, a wide spread of emergence in each of the counties due to a wide variation in the age of corn and consequently time of silking. The first increase on cotton in the Brazos River Bottom occurred on July 8. Oviposition on cotton was not as high as in 1939, but was distributed over a longer period. The highest oviposition on cotton in 1940 at the points examined was 32 eggs per 100 terminals.

Natural Control of Eggs and First Instar Larvae: Observations were made on 378 eggs laid on cotton plants. Forty per cent of these eggs hatched; 17 per cent were destroyed by the predacious sucking insect *Orius insidiosus,* 15 per cent by the egg parasite, *Trichogramma minutum,*

19 per cent were knocked from the plants by cultivation or wind, and 8 per cent were unaccounted for. Two hundred and seven first instar larvae were studied on the cotton plants. Sixty-eight per cent were killed by *O. insidiosus*, 7 per cent by spiders, 25 per cent bored into small squares or bolls or were inside the bracts at last observation; 28 per cent dropped or were blown from plants, and 7 per cent were unaccounted for. It was found that a small percentage of these first instar larvae dropping from the top part of the plants reached the bolls and were able to bore into the younger bolls.

R. K. Fletcher.

Control: Two series of tests were conducted for the purpose of determining the comparative effectiveness of cryolites, arsenate of lead, and calcium arsenates containing different percentages of water-soluble arsenic pentoxide for bollworm control. Special effort has been made to find an insecticide that will not only kill the worms, but which will give longer protection than calcium arsenate. Arsenate of lead and natural cryolite-sulphur (85-15) gave better control of the bollworm than the calcium arsenates or synthetic cryolite-sulphur (85-15). In general, the plats treated with arsenicals yielded more cotton than the plats treated with cryolites because the cryolites did not give adequate control of the weevil. Gains over the untreated plats ranging from 349 to 486 pounds seed cotton per acre were recorded for the various insecticides.

J. C. Gaines.

Thrips on Cotton

The catch of thrips on screen traps located in cotton was lower than in 1939. From 13 to 43 per cent of the cotton seedlings had the terminal buds injured. The peak of transfer from weeds to cotton occurred about the middle of May. From May 8 to 15 an average of 34 thrips were captured per day on one square foot of trapping surface in a weed field between cotton fields.

J. C. Gaines.

As in 1938 and 1939, counts were made of thrips injury to 36 varieties of cotton. Several varieties had over 50 per cent of the terminals uninjured, while in a number of varieties practically all of the terminals were severely injured. However, there was a wide variation in amount of injury from year to year.

R. K. Fletcher.

Rapid Plant Bug

Control: Populations of the rapid plant bug *(Adelphocoris rapidus* Say) develop late in the season and have been found capable of causing some injury. Experiments conducted during 1939 indicated that calcium arsenate with a high percentage water-soluble arsenic pentoxide gave control of the rapid plant bug, while a mixture of sulphur and commercial

calcium arsenate (2-1) gave a 39 per cent control. Records of rapid plant bug populations on several control experiments during 1940 indicated again that calcium arsenate containing a high percentage water-soluble arsenic pentoxide gave significant control of this insect over cryolites or arsenate of lead containing very little water-soluble arsenic pentoxide.

J. C. Gaines.

Cotton Insect Survey

(In cooperation with the Freeport Sulphur Company)

During June and July a cotton insect survey was conducted to secure definite information concerning the occurrence and abundance of boll weevil and flea hopper in several sections of the State. Information in regard to infestations found was given to the county agents, who were enabled thereby to keep the growers in close touch with insect conditions prevailing in 34 counties in South-Central, Southeast, North-Central, and North Texas.

Flea hoppers were found only in small numbers and did not warrant control measures. The highest average infestation occurred during the third week of July in North-Central Texas. In general, boll weevil infestations also were found well below the danger point until midsummer when the infestations approached moderately heavy proportions. Continued wet weather was favorable for weevil multiplication, and widespread damage was produced by this insect during the latter part of the season. The survey was discontinued the last week of July.

Two men employed in the survey travelled in a personal car and made 276 visits to 195 different farms in 34 counties.

W. S. McGregor, and F. L. Thomas.

A survey of insect problems affecting cotton production in the El Paso Valley was made during September. *Lygus elisus* and *Adelphocoris superbus* were found in all cotton and alfalfa fields examined. Injury to cotton bolls by insect punctures was widespread. An average of 35.3 per cent were "stung" and 20.1 per cent had stained lint. Boll damage and insect population were only slightly higher near the center of adjoining cotton fields.

S. E. Jones, F. L. Thomas.

Sulphur as an Insecticide

(In cooperation with the Texas Gulf Sulphur Company and the Freeport Sulphur Company)

Progress in this project is reported under Substations 15 and 19, the Laboratory for Truck Crop Insect Investigations, under Cotton Flea Hopper, and Fruit Insect Investigations.

Fruit and Nut Insect Investigations

A series of dormant spray tests was made to determine the effect of the overwintering hibernacula of the pecan leaf casebearer. Oil sprays used at a 2 per cent oil concentration containing .04 and .08 of dinitro-ortho-cyclo-hexyl-phenol were emulsified in the spray tank with a mixture of goulac and bentonite. A proprietary, "Dry Mix," made by adding the dinitro-ortho-cyclo-hexyl-phenol to the goulac and bentonite was used at a concentration of .08 per cent. Good control was obtained with each of the three sprays, but the highest concentrations proved most effective.

A 4 per cent oil emulsion, in which fish oil soap was used as the emulsifying agent, did not give as good control as the combinations of oil and dinitro-ortho-cyclo-hexyl-phenol. A proprietary 4 per cent oil emulsion gave better control than a 4 per cent fish oil emulsion, but neither proved as effective as the oil combinations with dinitro-ortho-cyclo-hexyl-phenol.

Two pounds of the "Dry Mix" containing goulac, bentonite, and dinitro-ortho-cyclo-hexyl-phenol added to 100 gallons of water was nearly as effective as the combinations in which dinitro-ortho-cyclo-hexyl-phenol was added to oil.

S. W. Bilsing.

During the early spring a control program for curculio *(Conotrachelus nenuphar* Herbst) on peaches was started at Nacogdoches. A schedule of five spray applications of lead arsenate, zinc sulphate, sulphur, and lime was made on peach trees. Yield data showed that 28 per cent of the fruit on the unsprayed trees and less than 1 per cent of the fruit on the trees sprayed with lead arsenate was infested with curculio. It developed that in mixed orchards of plum and peach trees the movement of weevils to peaches was delayed so that the arsenical sprays as usually recommended would have been too early.

A heavy infestation of Oriental fruit moth larvae *(Grapholitha molesta* Busck) was found in the orchard at Nacogdoches early in the season. Records made at harvest indicated that 15 per cent of the fruits on the trees sprayed with lead arsenate and 19 per cent of the fruits on the unsprayed trees were infested with Oriental fruit moth larvae. This pest was found in most peach orchards of the northern two-thirds of the State. It had not been reported since an early occurrence was discovered in Dallas about 1923.

W. S. McGregor.

Devil's Shoestring, *Tephrosia virginiana* (Linn.), as an Insecticide

(In cooperation with the School of Agriculture, A. and M. College of Texas, and the Bureau of Plant Industry, U.S.D.A.)

Studies on the seasonal variation in the rotenone and total extractives of the roots have been continued with results approximately the same as

for the previous season. It has been definitely proved that heredity and not soil or climate are the predominent factors influencing the rotenone in the plant. Plants grown in different localities and on other soil types retain their toxicity. Several hundred plants grown from seed of selected parents have been examined by means of both the Durham color test and by rotenone determinations. All were found to be toxic and approximating in rotenone content the original lot of selected plants. A satisfactory method of emasculating the flowers and cross pollination has been developed, and a number of crosses have been made. Further work with crown cutlings has been done with satisfactory results. Some preliminary work with indolebuturyic and indoleacetic acid has been done with encouraging results. A rose lifter has been used quite satisfactorily in harvesting the roots. Work is being conducted to develop a method of harvesting a portion of the roots without destroying the plants.

V. A. Little and G. A. Russell, Bureau of Plant Industry.

Truck Crop Insect Investigations

The work of the laboratory at Alta Loma in Galveston County is reported below; other work on truck and citrus crops is presented in the reports of Substations 15 and 19.

Turnip aphid *(Rhopalosiphum pseudobrassicae* **(Davis)** **)**: In the presence of an early and severe infestation a .10 per cent pyrethrin dust produced significantly better control than a .55 per cent rotenone dust. In other experiments with a light infestation dusts applied at the rate of 25 to 30 pounds per acre and sprays containing respectively .01 per cent nicotine and .03 per cent rotenone and applied at the rate of 90 to 130 gallons per acre were equally effective.

M. J. Janes.

Cabbage looper *(Autographa brassicae* **(Riley)**): Three applications of a sulphur-cube dust containing .66 per cent rotenone controlled the lopper and produced a gain of 1207 pounds of cabbage per acre.

Common red spider *(Tetranychus telarius* **(L.)** **)**: A finely ground conditioned dusting sulphur gave excellent control of this pest on strawberries. There was no evidence of any injury to the plants by the sulphur.

Flea beetle *(Phyllotreta vittata discedens* **(Weise)** **)**: A high degree of control of this insect on mustard was secured by a cube-sulphur dust for the third consecutive year. During the present year the dust contained .55 per cent rotenone. Dry pyrethrum-sulphur dust containing .1 per cent pyrethrins was also effective this season.

Southern green stinkbug *(Nezara viridula* **(L.)** **)**: Infestations of this insect on cow peas were materially reduced by applications of pyrethrum-sulphur dust containing .15 per cent pyrethrins.

M. J. Janes.

Citrus Insect Investigations

(Work under this subject is presented in the report of Substation No. 15)

Miscellaneous Insect Investigations

Corn earworm *(Heliothis armigera* **(Hbn.)) on flax:** Promising results were obtained with a calcium arsenate-Paris green (92½-7½) mixture to control the earworm on flax.

M. J. Janes.

Desert termite injury to native range grasses: Observations begun on this pest in 1939 were continued on eight different type areas in Wichita County. Records indicate that contouring of pastures and the removal of mesquite trees proved effective in increasing stands of native grasses despite the presence of moderately heavy termite infestations. Rainfall is seemingly the limiting factor in the injury produced by the desert termite. The insects normally appear to feed upon dead blades of grass, but when the amount of this material becomes limited they also attack the green parts of the plants. Soil moisture was sufficient during the current season for good growth and the stands of native grasses increased from about 30 per cent in 1939 to 60 per cent in 1940.

W. S. McGregor, F. L. Thomas.

Apiary Inspection for 1940

During the year 47,509 colonies of bees owned by 612 beekeepers were examined. Among the colonies 328 cases of American foulbrood were found and destroyed, showing .69 per cent infection. Thirty-eight queen-breeders were granted certificates.

C. E. Heard and W. C. O'Neal.

AGRONOMY

Oat Investigations and Improvement

Since the work under this project is conducted at Substation No. 6, Denton, the results are given in the report of that station.

E. S. McFadden.

Fertilizers for Field Crops

Experiments are being conducted at the Main Station, College Station, and at the substation at Angleton to determine the fertilizer needs of field crops.

Cotton is included in the work at both points. The yields of cotton in the experiment at College Station in 1940 were considerably lower than the average for the 14 years of the experiment. Of the 17 fertilizer treatments used, the treatment consisting of 12 tons of manure and 400 pounds of superphosphate made the highest yield in 1940 (306 pounds of lint per

acre), but the yield ranged down to 139 pounds per acre for the unfertilized soil. This treatment of manure and superphosphate also produced the highest average yield, 371 pounds of lint per acre, for the years 1927-40. The use of 200 to 400 pounds of a 4-12-4 fertilizer, however, probably has been the most profitable treatment.

On the Lake Charles soil at Angleton larger yields were obtained in 1940 than any of the previous nine years of the test. The yields ranged from 721 pounds to 968 pounds of lint per acre. For the nine years the treatment of 800 pounds per acre of 10-12-4 made the highest average yield, 547 pounds of lint per acre. The results, however, show that the soils are deficient in nitrogen and phosphoric acid and that the use of 200 to 400 pounds of 4-8-0 or 4-10-0 per acre or higher analysis fertilizers, as 16-20-0 and 5-15-0, give the most profitable results.

Corn also is included in the work at College Station and Angleton. In 1940, the yield at College Station was much higher than any previous year of the test. The yields varied from 60 bushels per acre from the treatment of 12 tons of manure and 400 pounds of superphosphate to 35.5 bushels from the untreated soil. Although the treatment of manure and superphosphate has produced the largest average yield, 33.7 bushels per acre, or 45 per cent more than the yield of the untreated soil for the 14 years, it has not been profitable. Applications of 200 to 400 pounds of a 4-8-4 or 4-12-4 fertilizer per acre have been more satisfactory.

The yield of corn in the experiment at Angleton was slightly higher in 1940 than the average for the 10 years 1930-40, and varied from 35.4 bushels to 43.4 bushels per acre. During the 10 years, the average yields ranged from 25.3 bushels per acre on the untreated soil to 37.9 bushels on soil treated with 800 pounds per acre of a 10-12-4 fertilizer. Although complete fertilizers have made the largest yields, the results indicate that the use of nitrogen only, such as 100 pounds of nitrate of soda or sulfate of ammonia or similar amounts of nitrogen in other suitable materials, give good results.

Oats are used in the experiment only at College Station. The yields in 1940 were considerably above the average and ranged from 73 bushels per acre on soil that received 12 tons of manure down to 31 bushels on unfertilized soil. Although some of the treatments increased the average yield of oats more than 50 per cent during the 14 years of the experiment, none have been decidedly profitable. The results show, however, that oats respond more readily to nitrogen than phosphoric acid or potash and indicate that the application of 100 pounds per acre of sulfate of ammonia or nitrate of soda should give good results.

E. B. Reynolds, R. H. Stansel.

Tests of Nitrogenous Fertilizers for Cotton

The purpose of this experiment is to determine the relative merit, or value, of different nitrogenous materials as fertilizers for cotton. Of the

five materials included in the test in 1940, sulphate of ammonia and uramon made the largest yields, 215 and 213 pounds of lint per acre, respectively. During the last nine years, however, nitrate of soda has produced the highest acreage yield, 269 pounds of lint per acre, which is only slightly higher than the yield of 258 pounds from soil treated with sulphate of ammonia. This slight difference in yield is probably not significant.

E. B. Reynolds.

Manganese and Boron as Fertilizers

Manganese and boron were applied to the soil in combination with 400 pounds of 4-8-4 fertilizer to determine their effect on the yield of cotton. The manganese was applied in 50 pounds of manganese sulfate and boron in 15 pounds of borax. The soil receiving the manganese produces 132 pounds of lint per acre; the soil treated with boron, 136 pounds; the soil treated with the 4-8-4 fertilizer, 215 pounds; the untreated soil, 106 pounds. Apparently, manganese and boron depressed the yield of cotton.

E. B. Reynolds.

Winter Legumes as Soil Improving Crops for Cotton

Hairy vetch is used as the soil-improving crop at College Station; hairy vetch and oats at Tyler; hairy vetch, oats, and a mixture of oats and vetch at Nacogdoches; and yellow annual sweet clover at Angleton. Some of the vetch plats are fertilized with 400 to 500 pounds of 0-8-4 per acre and others receive nothing. At Angleton some of the yellow annual sweet clover receives 400 pounds of 0-8-4 fertilizer per acre in the fall and 200 pounds in the spring for cotton after vetch has been plowed under. These soil-improving crops are planted in the fall, plowed under in the spring, and followed by cotton.

On the Lufkin fine sandy loam at the Main Station, College Station, in 1940 the plats on which fertilized vetch was plowed under made the largest yield, 320 pounds of lint per acre, or 74 per cent, more than the untreated soil. During the four years this treatment also produced the highest average yield, 284 pounds of lint per acre, which was 85 pounds, or 43 per cent, more than the yields from the untreated soil.

The test at Tyler is conducted in a two-year rotation of cotton and corn. The soil where the fertilized vetch was plowed under and which serves to determine the residual effect of vetch on the yield of corn the following year, made the largest yield of cotton in 1940, which was 503 pounds of lint per acre. This treatment also produced the highest average yield, 353 pounds of lint per acre, or 65 per cent, more than the yield from the untreated soil for the three years 1938-40.

The use of vetch as a soil-improving crop more than doubled the yield of cotton at Nacogdoches in 1940 and produced an average yield of 236 pounds of lint per acre, or 40 per cent, more than yield of the unfertilized soil for the three years 1938-40.

The plowing under of yellow annual sweet clover did not increase the yield of cotton appreciably on the heavy Lake Charles soils at Angleton in 1940 but increased the average yield about 13 per cent for the three years 1938-40. The clover has not produced enough vegetative growth to furnish enough nitrogen for the cotton even though it has been allowed to grow until too late to plow under for cotton.

The results obtained on the sandy soils at College Station, Nacogdoches, and Tyler show definitely that the plowing under of vetch furnishes an abundance of nitrogen for cotton following the vetch, that the application of 100 to 200 pounds of superphosphate per acre is necessary to secure the full benefit of the vetch, and that these treatments have increased the average yields of cotton 40 to 65 per cent.

E. B. Reynolds, P. R. Johnson, R. H. Stansel, and H. F. Morris.

Plant Introduction

New plants are introduced from time to time as opportunity permits and grown either at the Main Station or at the substations, but no outstanding plants were observed in the introductions obtained in 1940.

E. B. Reynolds.

Inheritance in Cotton

(In cooperation with the Bureau of Plant Industry, U. S. D. A.)

One of the objects of this work is to introduce the hairy condition of cotton into the better adapted, high-yielding staple varieties. It has been found that hairy plants retain poison better in insect control. Extremely hairy types have been recovered which may be used as stocks for further testing and comparison with the better commercial varieties.

The inheritance of leaf shape and color and their effect on yields were investigated further and the pure types combining the desired characteristics were grown for the purpose of obtaining seed for testing under field conditions to compare their yields with the yields of normal green-leaf stock used as the recurrent parent. Lines differing by only one main character, namely, okra-leaf, red-leaf, bronze-leaf, and virescent yellow leaf, have been developed through six generations of back-crossing to an inbred, normal upland parent. If any of these lines do not differ significantly, it will indicate that the particular character has no adverse effect on yield and consequently may be used as a genetic marker for transfer to a superior variety.

Fiber fineness and length in relation to the yield and cleaning qualities of cotton are being studied in crosses between Lightning Express and several varieties with short, coarse, fibers. Fiber and spinning tests of the new hybrid types will be made and the inheritance of the physical properties of the fiber studied.

Several extremely early maturing strains of cotton were obtained recently from Sodova, Bulgaria, which has a latitude comparable to that of northern Kansas. These were crossed with some of the better Texas grown varieties to study photoperiodic response to length of day and to study further the inheritance of earliness with other important economic characters.

D. T. Killough, T. R. Richmond, and R. E. Harper.

Cotton Variety Tests

In the Gulf Coast Prairie at Angleton, Beaumont, and in Nueces County the longer staple varieties were the most profitable. These include strains of Deltapine (D. & P. L. 11A, 12 and 44-51), Stoneville 2B and 5A, Washington (Delfos 719), Delfos 531 B, and Rogers Acala.

At Nacogdoches and Tyler on the sandy soil in the eastern part of the state, Deltapine (D. & P. L. 11A and 12), Hi-Bred, Half and Half, Rhyne's Cook Wilt-resistant, Rogers Acala, Texas Station hybrid 7-25-37, and Miller 610 were the high producers.

In the Blackland region at Temple, Rogers Acala, Buckellew Mebane, Bryant Mebane, Watson, Mebane (A D Estate) and Ferguson 406 were the leading varieties in point of yield.

At the Denton station in the Fort Worth Prairie, the more profitable varieties tested included Bryant Mebane, Sunshine 83-3 and 74-2, Mebane 804-50, Watson, Hurley Special, and Ferguson 406.

In the western part of the state the early-maturing Texas Station strains of Mebane 140 and 141, Texas station hybrids of Mebane and Lankart, Western Prolific, Half and Half, Hi-Bred, and Ferguson 406 were the better varieties.

Varieties well suited to areas where cotton is grown under irrigation and to valley lands include the longer staple types, such as Stoneville 2B and 5A, Rogers Acala, Deltapine (D. & P. L. 11A, 12, and 44-51) and Washington (Delfos 719).

D. T. Killough.

The Spacing of Cotton

The object of this experiment, conducted at College Station, is to determine if the spacing of cotton plants in the row should be different on poor soil and on more productive soil. The cotton plants are spaced 12, 18, and 24 inches apart in 3-foot rows on unfertilized soil and on soil that receives 400 pounds and 800 pounds of 4-8-4 fertilizer per acre. Low yields were secured in 1940, the yields ranging from 289 pounds of lint per acre for the 18-inch spacing on soil treated with 800 pounds of fertilizer to 123 pounds of lint from the 24-inch spacing on untreated soil. During the five years 1936-40 the 12-inch spacing produced an average yield of 257 pounds of lint per acre; the 18-inch spacing, 246 pounds; and the 24-inch spacing, 236 pounds. When the yields of all of the spacings are grouped together,

the untreated soil made an average yield of 184 pounds of lint per acre for the five years; the soil treated with 400 pounds of fertilizer, 263 pounds of lint; and the soil that received 800 pounds of fertilizer, 292 pounds of lint. These results on Lufkin fine sandy loam show that the 12-inch spacing produced larger average yields of cotton than wider spacing on soils of different levels of fertility.

E. B. Reynolds.

The Study and Improvement of the Peanut

The project is conducted on the Main Station Farm and the results for 1940 are given in the report of that station.

J. E. Roberts.

Rice Improvement and Method of Production Tests

(In cooperation with the Bureau of Plant Industry, United States Department of Agriculture)

All of the work with rice under this project is conducted at Substation No. 4, Beaumont. The project embraces work on (a) breeding and selection; (b) testing of varieties and new strains developed in the breeding work; (c) time, method, and rate of application of fertilizers; (d) studies on irrigation; (e) studies on rice diseases, especially the black kernel disease. The results of the work in 1940 are given in the report of Substation No. 4.

R. H. Wyche, H. M. Beachell.

Factors Affecting Storage of Water in the Soil and Methods of Effecting Maximum Storage in Relation to Conservation of Water and Soil Resources

(In cooperation with the Soil Conservation Service, United States Department of Agriculture)

This work is conducted at Spur station and the results are given in the report of that station. The results of the work for the 14 years, 1926-40 were published in 1940 as Bulletin No. 587, entitled "Water and Soil Conservation Experiments at Spur, Texas."

R. E. Dickson, C. E. Fisher.

Pasture Improvement and Management for East Texas

As this project is concerned largely with the practical improvement and management of pastures on farms of Substation No. 2, Tyler, and Substation No. 4, Beaumont, the results obtained in 1940 will be given in the reports of those stations.

E. B. Reynolds.

Inheritance and Improvement in Corn

Various open-pollinated hybrid combinations were included in the regular test with commercial varieties of corn in 1940. The different groups

of hybrids included were (1) commercial hybrids obtained from other states, (2) hybrids produced by crossing cornbelt single crosses with Texas inbreds, and (3) hybrids developed by the Texas Station. Results from all substations where the tests were conducted showed that Texas hybrids as a group gave the highest yields, averaging approximately 20 per cent more than the commercial varieties. The hybrids produced by using cornbelt single crosses and Texas inbreds also gave substantial increases in yield over the commercial varieties, but on the whole did not yield so well as the Texas hybrids. Commercial hybrids at several of the substations did not yield as well as the commercial varieties and at others they yielded only slightly more than the commercial varieties. The commercial hybrids were also much more susceptible to ear worm and weevil damage than commercial varieties or Texas hybrids.

In 1940 for the first time hybrid seed corn was produced in Texas in sufficient quantities to offer for general planting, approximately 400 bushels being produced from desirable, high-yielding inbreds for distribution to seedsmen for the production of commercial hybrid seed corn. Approximately 30 acres will be planted to crossing blocks in 1941 for the purpose of producing single cross seed.

A sweet corn hybrid test was conducted at College Station, Winter Haven, and Weslaco in 1940, and several hybrids proved very promising in respect to yield, quality, and protection against ear worm damage. The inbred strains used in the better hybrids are being increased, and stock seed should be available for commercial production in 1942.

The results of testing hybrids in 1940 and a summary of the variety test results for the past ten years have been published as Progress Report No. 709.

P. C. Mangelsdorf and John S. Rogers.

Breeding Cotton for Mechanical Harvesting

(In cooperation with the Division of Agricultural Engineering)

A number of varietal types of cotton having different plant, boll, and fiber characters are being studied to determine the effect of these characteristics on the mechanical harvesting and cleaning of cotton. Through breeding, the more important characters are being combined in desirable types.

Harvesting tests thus far indicate that a desirable type of plant from the standpoint of mechanical harvesting should be characterized by medium height, relatively short noded fruiting branches, not more than one minor vegetative branch, an open-type growth, light foliage with small leaves that shed early and a medium-sized, strong storm-resistant boll, borne singly on a peduncle that snaps easily under tension. In addition, the fiber should be relatively harsh bodied, dense on the seed, of medium staple length, and have sufficient interseed drag to keep the locks relatively compact for best results in cleaning mechanically harvested cotton.

During 1940 the breeding work at College Station and Lubbock showed several promising hybrids which appear relatively uniform for the characteristics being sought. Backcrossing and continued selection and selfing in the F_2 and subsequent generations has resulted in the development of Texas Station hybrids, Half and Half x Acala, Ducona x Mebane 140, Clark x Acala, and Half and Half x Lone Star, all of which are characterized by a high mechanical harvesting efficiency, high yield, good cleaning qualities, desirable staple length, and relatively high percentage of lint. The improved strains are being increased.

D. T. Killough, H. P. Smith, D. L. Jones, M. H. Byrom.

Variety Test of Soybeans

The work is conducted at the Main Station, College Station, and at the substations at Angleton, Beeville, Denton, and Tyler. All of the varieties in the test at College Station were practical failures for seed production in 1940 and for the five years 1936-40. The results at the other stations in 1940 appear in the reports of those stations.

E. B. Reynolds.

Breeding Small Grains for Resistance to Rust

(In cooperation with the Bureau of Plant Industry, U. S. Department of Agriculture)

Breeding work in developing rust resistant varieties of wheat, oats and barley has reached the stage where two strains of wheat from the Hope x Mediterranean cross are being increased in field plots on the Temple substation for commercial distribution in the fall of 1941 provided further milling and baking tests continue to indicate that they are suitable for bread or pastry purposes. These wheats have proven to be well adapted to conditions in the Central Blacklands as represented by the Temple substation.

Approximately 5,000 wheat plant selections were made in 1940 from crosses designed to give rust resistant wheats adapted to conditions in the Gulf Coast area and the extreme southern part of the Blacklands. After a one-year test at College Station, the more promising of these strains will be distributed to the more southern substations of the state for further trials.

A total of over 1600 foreign wheats introduced from various parts of the world by the Division of Plant Exploration and Introduction have been tested for rust resistance at College Station during the past four years. From this list of wheats, 43 varieties have been isolated that have con-

sistently showed greater resistance to stem rust than Kota wheat, the first rust resistant spring variety discovered in this country. It is believed that several new factors for resistance occur in these wheats, and that they may prove of considerable value in breeding new rust resistant varieties adapted to various conditions.

Two promising strains of oats from the cross Nortex x Victoria, heretofore designated as M19-17 and M19-19, have been officially named Ranger and Rustler respectively, and are now being increased at Temple and College Station for general release in the fall of 1941. These varieties are practically immune to crown rust and are of earlier maturity than the old Texas Red types.

Some 3,000 hybrid strains of oats selected for resistance to both stem rust and crown rust have been reduced to 25 strains which give promise of being well adapted to the Gulf Coast Region and for growing under irrigation in the Lower Rio Grande Valley. One of these strains, Selection 5542-1 x 1415-8 x 34BQ-3-36-6, gave a computed yield of 98.5 bushels per acre under irrigation at Weslaco in 1940 where the New Nortex checks were destroyed by stem rust.

Several varieties of barley that are resistant to leaf rust and promise to be well adapted to environmental conditions in the Lower Rio Grande Valley have been isolated from a large number of foreign introductions that have been tested. One of these varieties, Abacus, C.I. 1088, gave a yield of 82.6 bushels per acre in a rod-row nursery grown under irrigation at Weslaco in 1940 under conditions where certain of the susceptible check varieties produced no seed at all. Crosses have been made between several of the more promising leaf rust resistant varieties and the varieties Peatland and Chevron which are resistant to stem rust. A few hybrid strains that are resistant to both rusts have been isolated from some of these crosses.

E. S. McFadden, Bureau of Plant Industry,
P. C. Mangelsdorf.

Effect of Fertilizers on Yield, Chemical Composition, and Botanical Composition of Pasture Herbage

(In cooperation with the Tennessee Valley Authority)

This work is conducted at Angleton, College Station, Lufkin, and Tyler.

On the Lake Charles soil at Angleton the soil that received 40 pounds of nitrogen and 80 pounds of phosphoric acid per acre made the largest yield in 1940, 2370 pounds of air-dry forage, or 76 per cent more than the unfertilized pasture. This treatment also produced the highest average yield, 3474 pounds per acre, or 52 per cent more than the untreated pasture, for the five years 1936-40. Although these are rather large increases in yield it is doubtful if they were profitable.

At Lufkin the application of superphosphate alone has produced about as large yields of air-dry pasture forage as the application of complete fertilizer. This fact indicates that the use of phosphoric acid is necessary for establishing good, improved pastures in that part of the state.

The results secured at College Station in 1940 and for the five years 1936-40 show that fertilizers have not produced profitable increases in yield of pasture forage.

E. B. Reynolds, G. S. Fraps, R. L. Hensel, J. H. Jones.

Improvement of Range and Pasture Plants

During the year 236 different buffalo grass crosses were made, many of them backcrosses. Of the controlled crosses made in 1938, 97% are still living. The resemblence of the hybrids to their parents in one or more measurable characters as follows: 14.5% resembled only the female parent; 10.4% resembled only the male parent; 31.1% resembled both parents in an equal number of characters; 36.3% resembled both parents but in a disproportionate number of characters; while 7.3% resembled neither parent. Of the perfect-flowered plants five are still living, four of which are predominately staminate, and of these, three show the perfect-flowered habit. The fifth plant is pistillate.

In 1937 attempts were made to cross Rhodes grass *(Chloris gayana)* and Texas crowfoot *(Chloris cucullata)* in order to ascertain if cold resistance could be incorporated in the former. These seed were planted in the field in 1938 and of the hundreds of resulting plants, only one showed any resemblance to Chloris gayana. Seed from this plant were gathered and planted in the greenhouse. There were 38 seedlings, which were transplanted to the nursery in the spring of 1940 and grew vigorously. They do not resemble Chloris cucullata in any respect, nor do they resemble Chloris gayana except that they have stolons and the inflorescence resembles this parent. The plants are uniform, dark green, leafy, produce an abundance of seed stalks, and are comparatively drought resistant. Cold resistance has not yet been determined. Chromosome counts will be made this year to determine whether these plants are a true cross or a result of apomixis.

Crosses between Angleton grass *(Andropogon annulatus)* and yellow beard grass *(Andropogon ischaemum)* have been made. The F_1 generation is now growing in the greenhouse. Plat plantings for seed were made of *Paspalum malacophyllum*, Paraguay strain of Bahia grass, *Panicum antodotale*, Haddon's grass, yellow beard grass, and Angleton grass. Considerable seed of all of these was gathered and will be sent to substations for further trials. Plantings of tall fescue from the Bureau of Plant Industry at Corvallis, Oregon were made in the fall of 1939 at College Station and Denton where they showed good results. *Phalaris tuberosa* planted at the same time has also done well.

R. L. Hensel and G. C. Warner.

Limiting Factors in Pasture Production

Point quadrat analyses of the vegetation in the fertilizer plats at Beaumont and Lufkin were made in May and again in August, 1940. At the Beaumont station where superphosphate was added, there was a marked increase in the Trifolium clovers but a decrease in common lespedeza and carpet grass. The decrease in the lespedeza may be attributed to the late spring and early summer competition of the clovers which undoubtedly shaded out the young seedlings and prevented further growth. Dallis grass grew best where superphosphate was added and carpet and Bermuda grasses showed to best advantage where superphosphate was omitted. On the other hand, at Lufkin, which is on a different soil type, carpet grass, Bermuda grass, Dallis grass, and common lespedeza responded to superphosphate. In the fall of 1936, 3 pounds of white clover and 2 pounds of hop clover per acre was planted on all of the pastures. Plant analysis made in 1940 shows that the stand now consists of practically equal amounts of both, indicating that the hop clover is perhaps better adapted to the region than is white clover.

R. L. Hensel and G. C. Warner.

Management of Grazing Lands

In August 1940, six permanent point quadrat stations were located in each of the eight 5-acre pastures at the Lufkin station. These were charted to determine the botanical composition since each pasture was originally seeded to different mixtures of grasses and clovers in 1936. When these seedlings were fully established a daily rotation from one pasture to another was continued until 1938. The analysis showed several interesting facts; one of the most interesting was that all of the pastures showed fair percentages of Dallis grass although this grass was sown only in pasture 8 where it now makes up the largest percentage of grass. It is assumed that seed were carried to the other pasture by livestock. Common lespedeza was able to maintain itself fairly well in this pasture which may be due in part to the tuft rather than turf-forming habit of this grass. Carpet grass which was sown as a part of the mixture in all of the pastures shows a wide fluctuation in percentage in the different pastures. Just why this should exist is not clear. A more complete discussion of management practices will be found under the report of the Lufkin station.

At the Texas Range Station, 100 additional permanent point quadrat stations were established in September. This was done in order that all soil types would be equally represented. Data assembled this year show an increase in bitterweed *(Actinea odorata)*, due largely to rains which fell at a favorable time for germination. Quadrat data show that there was considerably less available grass than in 1939 with the exception of pasture N which had not been grazed since March. A more detailed discussion of the results at this station will be found in the report of the Sonora Station.

On the Texas Range Station near Ozona, mesquite has increased in all pastures where sheep are grazed alone or in combination with cattle over a period of two years. Where cattle alone were grazed, a decrease occurred. It is still too early to draw any definite conclusions from these data.

Bitterweed control will be discussed in the report of the Sonora station.

R. L. Hensel and G. C. Warner.

Wheat Breeding and Production in the Panhandle-Plains Region

(In cooperation with Soil Conservation Service, U. S. D. A.)

This project was begun at Amarillo in 1938 with a twofold purpose: (1) to develop varieties better adapted to climatic conditions of the region, and (2) to test and develop types of culture which will give maximum production compatible with methods of soil conservation.

Sixteen varieties and strains were grown in 1/55 acre plots in quadruplicate on dryland and also under irrigation in 1940. The yields from the commercial grown varieties in these plots, and in cooperative variety tests with certain wheat growers over a period of years, give the following yields: Blackhull 13.8 bushels per acre, Tenmarq 13.7, Kanred 13.5, Certified Turkey 12.4, Early Blackhull 12.2, Cheyenne 13.4, and Chiefkan 13.9. Of these varieties, Blackhull, Tenmarq, and Turkey are recommended on the basis of quality tests and other agronomic characteristics. None of the new strains were significantly higher in yield than the standard varieties.

An advanced nursery of 97 varieties was also grown in quadruplicate 3-row, 16-foot plots on irrigated and dry land. Several of the strains of (Kanred x Hard Federation) x Tenmarq appear to be promising from the standpoint of yield, test weight, agronomic characteristics, and preliminary quality tests. In addition, a replicated preliminary nursery of 8-foot rows and also a nursery of single 8-foot rows are grown which include later selections from some of the same crosses and also new introductions and selections from new hybrids. Included this year were over 600 strains received from the Division of Foreign Plant Introduction of varieties collected from the drier portions of the world.

Cultural methods are being tested in cooperation with the Research Division of the Soil Conservation Service. Plots have been laid out to test the effect of different types of tillage preparation for wheat with relation to protection offered from wind erosion. Strip cropping is also being carried on to test the most effective widths and spacings and the best direction in which strips of sorghum can be planted to offer the most protection to alternate strips of wheat. Data were obtained only in 1940 and because damaging winds were not frequent, the results were not sufficiently significant to make recommendations.

D. A. Reid.

Cytogenetics and Improvement of Cotton

A hexaploid produced by doubling the chromosome number with colchicine in a hybrid of *G. hirsutum* x *G. Anomalum*, a wild African species, had remarkably regular meiotic chromosome behavior, a pollen fertility of about 85 per cent, fibers finer than upland and with finer convolutions, doubled and crossed with *G. hirsutum* (Coker 100) and backcrossed to the *G.* but the yield of fibers was too low for the hexaploid to be of commercial value. The hexaploid has been backcrossed twice to upland.

Seeds produced from plants of *G. arboreum* (Nanking Asiatic cultivated) x *G. thurberi* (Wild American) in which the chromosome number was *hirsutum* gave an extremely variable population. Some of the plants were prolific but the percentage of lint was low. The fibers from some of the plants were finer than fibers of the upland parent, had fewer convolutions, and was stronger. Self-pollinated seeds were produced on these plants and the more promising ones were transferred to the greenhouse where they are being backcrossed again to upland.

About 30 plants from a hexaploid of upland (Half and Half) x Asiatic (Nanking) backcrossed twice to upland gave a range in fertility from 0 to more than 50 per cent. All of the plants examined had over 26 pairs of chromosomes and some had 4-5 extra chromosomes—chromosomes from the Asiatic parent. As many as possible of the plants were self-pollinated and also backcrossed again to the upland parent. Some of the plants had fibers coarser than upland and some plants showed some of the resistance to angular leaf spot that is possessed by the Asiatic parent.

Plants selected for high fertility in the F_2 of a hexaploid of *G. hirsutum* (Half and Half) x G. Arboreum (Nanking) gave progenies with approximately the same percentage of sterile plants as the F_2 progeny.

Doubling the chromosome number in a plant in which about half of the homologous chromosomes failed to pair did not increase the percentage of chromosomes that pair. This shows that doubling chromosome number does not increase chromosome pairing of plants in which pairing is interfered with by a gene combination. Doubling chromosome number in hybrids in which pairing is prevented by different arrangement of genes in the chromosomes is followed by approximately normal pairing.

J. O. Beasley and T. R. Richmond.

Adaptation and Improvement of Legumes

The objectives of the project, which was begun in 1940, are to determine the adaptation of legumes in the state and to develop strains of legumes of superior production and quality. Since the work was started in the spring, it was possible to include only soybeans and sweetclover. Other legumes will be included as the work develops. A large number of varieties and strains of sweetclover were planted at the Denton station for observa-

tion of forage and seed production. Results of these plantings, which included only biennial strains, will not become available until 1941.

Introduction nurseries of soybeans were planted in the spring at Chillicothe, Denton, Tyler, and College Station. Conditions were favorable for satisfactory growth. Early maturing types gave the highest yield of seed. Many late types were suitable for forage and soil building.

Sixty strains of soybeans which varied widely in maturity when planted in the spring, showed no marked differences in maturity when planted at Weslaco in the Rio Grande Valley September 15. All strains produced ripe seed in less than 90 days from date of planting. The yield of seed ranged from 2.0 to 13.5 bushels per acre. A similar test was conducted at Beeville but a freeze in November killed the plants when they were 4 to 10 inches high and consequently yields of forage and seed were not obtained.

K. F. Manke and E. B. Reynolds.

Development of New Varieties of Cotton by Varietal and Species Hybridization

This project, which became effective July 1, 1940, is conducted in cooperation with several of the substations and has as its object the development of a more intensive cotton breeding program for the state. The procedure to be used will be hybridization of varieties followed by selection and replicated field tests. F_1 hybrids were made between several varieties of upland cotton. A few F_1 hybrids were made between Sea Island and upland varieties. Some F_1 plants are now being grown this winter in the greenhouse at Substation No. 11, Nacogdoches.

J. O. Beasley, T. R. Richmond, and D. T. Killough.

The Use of Growth Promoting Substances for the Treatment of Cotton Seed

The readiness and profusion with which adventitious roots were formed by hardwood stem cuttings and transplanted rootstocks of mature cotton plants following the treatment of their basal cuts with indolebutyric acid in aqueous solutions of 100 parts per million were previously reported in 1938 and 1939. In attempts to make further utilization of this response of cotton to indolebutyric acid and similar growth promoting substances a number of lots of cotton seed was treated with these materials during 1940. In making these treatments it was anticipated that some of the materials used might exert a beneficial influence on the root development of the cotton seedlings, particularly in stimulating the formation of an increased number of lateral roots along the upper portion of the taproot.

To avoid wide fluctuations in the environmental condition not under test, the observations made in 1940 were limited largely to 10-day old cotton seedlings grown in sand under greenhouse conditions. Seed of the Watson variety was used and each sample consisted of a minimum of 100 seeds. The treated seeds were soaked for 24 hours in an aqueous solution of the

material and concentrations to be tested while the untreated seeds were soaked in tap water for the same duration. All seeds were dried thoroughly before planting. Ten days after emergence a count was made of the number of lateral roots produced on the first inch of each seedling taproot.

Although significant increases in the number of lateral roots produced within the first inch of the taproot were obtained from optimum concentrations of indoleacetic and naphthalene acetic acid, the maximum responses were secured with indolebutyric acid. Grown under summer light conditions and with a mean temperature of 80° F., 10-day old cotton developing from seed treated with indolebutyric acid in aqueous solution of 250 parts per million produced an average of 21.3 lateral roots within the first inch of the taproot compared to an average of 12.6 for seedlings from untreated seed. Under the same conditions highly significant responses also were secured from seed treated with indolebutyric acid solutions of 50, 100, 150, 200, and 300 parts per million. A correlation coefficient of .4097 ± .0227 was obtained between the concentrations of indolebutyric acid used and the number of lateral roots produced. The maximum response, however, was obtained from 250 parts per million. The extent to which the response of cotton seedlings to indolebutyric acid may be influenced by light and temperature conditions under which they are grown has not yet been fully determined.

H. E. Rea.

Cotton Breeding and Genetics

(In cooperation with the Bureau of Plant Industry, United States Department of Agriculture)

Experiments in the accumulation of lint production modifiers in certain smooth seeded lines were continued this year. Eighty-six progenies were grown from the three most promising families observed last year. Of these, 77 bred true for smooth seed, 20 of which were uniformly high in percentage of lint with an average of over 20. Several of the better lines will be crossed with high yielding, covered seeded, normal lines to test the possibility of increasing the lint production in normal stocks with the modifying genes accumulated in the smooth-seeded stocks.

A yield trial of sixteen first generation hybrids of *G. hirsutum* and *G. barbadense* was conducted. Hybrids of early maturing upland types such as Half and Half, Stoneville, Delfos, and Nucala with Sea Island gave the best yields. Several of the hybrids produced at the rate of 450 pounds or more to the acre, which approximates the yield of the better upland varieties grown in an adjacent test.

The open pollinated seeds obtained from the insect pollination tests in which upland and barbadense cottons were planted in alternate rows in areas frequented by bees, were planted in a one-eighth acre block at the rate of 40 pounds to the acre. As the upland parent stock carried the

gene for red leaf, all of the intermediate red plants in the plat were hybrids and were left at thinning while the full red-leaf upland and the green leaf barbadense plants were removed.

One phase of the study of species hybrids has been an attempt to transfer single characters observed in segregating generations of upland x barbadense hybrids to upland cotton and to build up lines that, except for a particular character, are essentially upland in type. The characters, hirsute and petal gland, were recovered from first backcross generations, indicating at least partial dominance. Selfed progeny of these crosses threw individuals in which the expression of both characters was greatly intensified. Other characters recovered in the selfed progeny of backcrosses, but not observed in the initial backcross progenies were: dark yellow pollen, bright flower bud, scattered boll gland, dwarf plant, and extra carpellary knobs.

T. R. Richmond, R. E. Harper, and J. O. Beasley.

Variety Test of Castor Beans

The variety test of castor beans was conducted at the Main Station, College Station, and at the substations at Beeville, Tyler, Angleton, Beaumont, Temple, Lubbock, Weslaco, and Iowa Park in 1940. The results obtained at College Station only are reported but the results at the substations are given under the reports of the substations concerned. Of the eight varieties in the test at College Station, the Connor variety made the largest yield, 11.6 bushels (535 pounds) of seed per acre in 1940 and the highest average yield, 9.4 bushels, for the two years 1939-40. In 1940 the percentage of seed to harvested weight of pod of the several varieties varied from 64 to 73 with an average of 68 for the eight varieties.

E. B. Reynolds.

Flax as a Winter Crop in South Texas

(In cooperation with the Bureau of Plant Industry, U. S. Department of Agriculture)

Experiments in the production of flax as a winter crop in South Texas met with some reverses in 1940 as a result of a period of extremely cold weather during the month of January which caused almost complete winter killing in all varieties at College Station and severe injury to nearly all varieties at Angleton. On the Angleton substation where temperatures dropped to 10 degrees F., one variety from Turkey gave a 90% spring survival compared with 1% for the Punjab check. This variety from Turkey and several others with somewhat lower spring survivals gave very satisfactory seed yields. In a special winter-hardiness nursery consisting of ten varieties, which was grown at College Station, Temple, Balmorhea and Denton, the variety, Roman Winter, proved to be the most winter-hardy of the varieties grown. These observations suggest the possibility

of finding or producing varieties adapted to Texas conditions that can be safely produced much farther north than the commercial varieties now available.

Due to the dry fall of 1939, the 1940 acreage of flax grown from fall seeding in Texas was probably lower than in the preceding year. A considerable acreage, however, was seeded after January 1st following heavy rains the last week in December. The seedings made the first half of January were practically all destroyed as far south as Corpus Christi by a period of cold weather between January 19 and 23 which caught the plants at their most tender stage of growth. Other seedings made during the latter part of January and up until after March 1 gave fair to good seed yields, as a result of exceptionally cool weather during the blooming and filling periods in May and June.

E. S. McFadden, Bureau of Plant Industry,
P. C. Manglesdorf.

Inheritance and Improvement in Sorghums

Resistance to Pythium root rot has now been transferred to all of the old susceptible varieties commonly grown in Texas with the exception of Wheatland milo. These new varieties include Standard, Dwarf, Double Dwarf, and Sooner milo, all yellow-seeded varieties, Dwarf White and Early White milo and Darso. These varieties have received wide distribution and are now in general use almost to the exclusion of the old strains. The new disease resistant strain of Sooner milo developed by crossing the susceptible Sooner variety with a resistant Dwarf Yellow strain and selecting the early types resistant to Pythium was distributed to growers for the first time this year. Milo root rot infestation was general throughout the State again this year, causing greatly reduced yields. Resistant Dwarf Yellow milo at the Lubbock Station produced 24 bushels to the acre, more than three times as much as the old susceptible variety, which yielded only 7.1 bushels to the acre.

Attempts have been made to find a sorghum resistant to Charcoal rot (Sclerotium bataticola) but results have not been very encouraging. Enormous losses were sustained this season from Charcoal rot which was observed all over the High and Low Plains areas. Susceptiblity of the sorghums rank in about the following order: Milos, Darso. Sudan grass, feterita, Hegari, kafir and the sweet sorghums. Damage from Charcoal rot occurs about the time the crop is beginning to mature and causes shriveling of the grain and lodging of the plants. When ample moisture prevails at time of maturity damage from this disease is less apparent. Since varieties resistant to Pythium root rot are now in general use Charcoal rot is the most serious disease affecting sorghums.

Breeding work with Sudan grass has progressed satisfactorily during the year. The objective of this breeding work is to produce new synthetic varieties of Sudan grass having valuable economic characters not present

in the old variety. A sweet sorghum known as Leoti is being used as one of the parents to cross with Sudan grass with a view of transferring from the sweet sorghum parent into new Sudan grass strains such valuable characters as sweet stem, juicy stalk, non-shattering seed habit, a distinctive glume color and resistance to bacterial foliage diseases. Several hundred selections resulting from four and five backcrosses to Sudan grass are now being grown in comparative experimental trials in order to determine the relative merits of these selections. Grazing tests of the more promising selections in comparison with ordinary Sudan grass are being conducted at several of the Substations. Readings upon disease resistance are being obtained at the Weslaco Station and in cooperation with the Division of Forage Crops and Diseases of the U. S. Department of Agriculture at Arlington Farm. A number of the more promising selections are being grown at the Wisconsin Station and tested for HCN content with the view of developing a strain low in prussic acid. It is planned to develop increased seed supplies of several of the best strains for early distribution.

Other surghum breeding projects have as their objective the development of Blackhul kafir and Yellow milo varieties having sweet stems and higher forage value, yellow-seeded varieties of kafir, Hegari and feterita, and white- and yellow-seeded varieties of sorgo resistant to leaf spot diseases. A new strain of Hegari which is about fifteen days earlier than Hegari has been tested at a number of the Substations for several years and found to be worthy of distribution as a new variety under the name of Early Hegari. It yielded seven bushels more to the acre than Hegari on the average at six of the Substations during the past year. Early Hegari is a surer and safer variety to grow under dry conditions, on the High Plains, and at the higher latitudes in the sorghum region.

Important discoveries during the past two years have led to critical studies of physiological responses in sorghum which promises to satisfactorily clarify and explain many of the major varietal differences and also varietal adaptation in sorghum as well as in many of our other important crops. It also appears that the major part of the hybrid vigor encountered in certain sorghum crosses can be explained by the heterozygosity of a very few genes concerned with physiological responses. Numerous combinations of crosses are being studied in the F_1 and F_2 generations with particular reference to blooming dates, leaf number and height of plants. A number of contrasting varieties have been grown and observed under different lengths of day by planting at different dates as well as under artificial exposures. Results this year indicate that earliness as contrasted to lateness in maturity in sorghum is brought about by unlike physiological responses to environment. Earliness is associated with low internode number and lateness with high internode number. Plants subjected to environments approaching the critical with respect to photoperiod are slow in initiating their heads so that more internodes are laid down and maturity is delayed. Under ten hour days

sorghum heads are initiated about three weeks after planting. Under a fourteen hour day Early milo initiated heads thirty-three days after planting while Milo initiated heads forty-nine days after planting.

Early milo and Milo differ from one another by a single gene that controls response to photoperiod. Lateness is dominant to earliness when these two varieties are crossed. In certain other crosses earliness is dominant to lateness and this is taken to indicate that a second major gene is in operation and that this gene probably controls some response other than photoperiod.

The recessive condition of the gene that controls response to photoperiod allows the early heading of Early milo even under a fifteen hour day. Early milo is adapted, therefore, to a region north of that where Milo itself is adapted. In the Southern Great Plains Region the later variety, Milo, which has the gene in the dominant condition is the better adapted.

Great differences in growth and production occur between F_1 hybrids which have one parent in common and whose other parents differ only in the condition (recessive or dominant) of the gene that controls response to photoperiod. At Chillicothe in 1940 a plat of F_1 plants of Kafir x Early milo produced 57 bushels of grain per acre. A plat of F_1 plants of Kafir x Milo produced 122 bushels per acre. This difference of 65 bushels per acre resulted from a difference in growth brought about by a difference in a single gene. This difference in growth brought about by the dominant or recessive condition of one gene is of such magnitude as to arouse speculation regarding the nature of hybrid vigor.

R. E. Karper, J. R. Quinby, D. L. Jones.

The Genetic and Cytological Relationship of Zea, Tripsacum, and Euchlaena

Since the ear, with its many rows of grain, is the most unique organ of the maize plant, evidence as to how it originated is important in the problem of the origin of maize. In an effort to obtain evidence on this question, a study of the morphology of the ear has been undertaken and carried nearly to completion. The study has produced no evidence that the ear is the result of the fusion of few-rowed spikes, such as those of teosinte; in fact, it would be difficult, if not impossible, to bring the observations into accord with such a view. The morphology of the ear was compared with the spike of *Chloris berroi* Arech., which undoubtedly is the result of fusion of simple spikes, and the features of the spike of *C. berroi,* which clearly indicate its origin by fusion, were lacking in the maize ear. The vascular system of the cob is similar to that of the culm, and any explanation which assumes it to be a compound structure is superfluous. The deficiency of ears having numbers of rows indivisible by four may be accounted for in any of several ways, one simple explanation being that one pair of alleles, perhaps accompanied by partial dominance and a few modifiers, controls four rows of grains (two rows of alicoles).

The view that the maize ear descended from the teosinte spike by mutations which directly increased the number of rows of grains without the fusion of simple spikes was likewise found to be untenable. The many-rowed maize ear differs from the two rowed teosinte spike by a considerable number of genes, and none of these genes has been known to mutate in the direction of maize. The reason for this probably is that in the majority of these genes maize has the dominant allele.

The theory that the ear descended from a panicle similar to the maize tassel by a reduction of branches is in agreement with all facts known to us, and since this theory is widely applied to polystichous spikes of other plants it obviates a special explanation for maize. Therefore, there seems to be no satisfactory explanation of how the maize ear could have descended from the teosinte spike.

A comparative morphological study of maize, teosinte, and Tripsacum is well under way. To date, 55 characters have been studied and in 54 of them teosinte is either like maize or Tripsacum, or else intermediate between them. The single exception is depth of alveolus of the rachis, and even here the apparent exception may be the result of the rachis envelopment by a spathe. Thus only one possible character of teosinte has been found that it might not have acquired from either maize or Tripsacum.

Comparative studies of chromosome morphology of maize from various locations in South America have been continued. A total of 88 varieties has been examined and the average number of knobs found on the chromosome complexes of those from various countries is as follows: Argentina 2.00, Chile 3.00, Uruguay 5.00, Paraguay 2.31, Bolivia 0.26, Brazil 4.07, Peru 0.39, Dutch Guiana 3.40, Ecuador 0.00, Venezuela 5.50, Colombia 7.00, Guatemala 9.71. These results are in further agreement with our hypothesis, previously announced, that the original pure maize had knobless chromosomes, and that the knobs occuring on present-day varieties are the results of the infusion of teosinte, and therefore Tripsacum, chromatin into maize.

P. C. Mangelsdorf and R. G. Reeves.

MAIN STATION AGRONOMY FARM

The Main Station Agronomy Farm is located on the land of the Agricultural and Mechanical College of Texas at College Station, Brazos County. The station comprises 101 acres of land, 76 acres of which are used for experimental purposes and the remaining acreage for buildings, pastures, and roadways, and for the production of seed of superior strains of crops on the farm for distribution to farmers. A large percentage of the land is made up of Lufkin fine sandy loam soil.

Rotation and Soil Improvement Investigations

In this series of experiments only the non-rotation test with cotton, has been continued. This test consists of ten plats, some of which receive

no treatment, one plat receives no treatment and has the crop residue removed, and others receive superphosphate, rock phosphate, manure, manure and superphosphate, manure and rock phosphate, and manure and cottonseed meal.

During the 27 years, (1914-40), those plats receiving manure, either alone or in combination with superphosphate or rock phosphate have made the greatest yields. The treatment of manure alone produced 239 pounds of lint cotton to the acre, manure and rock phosphate produced 229 pounds, and manure and superphosphate produced 213 pounds. The average of the three no-treatment plats for the same period was 185 pounds.

Fertilizer Experiments

The object of this test is to determine the fertilizer needs of cotton, corn, and oats on the Lufkin fine sandy loam soil. The test consists of a three-year rotation of cotton, corn, and oats in which a 4-12-4 fertilizer at the rate of 400 pounds to the acre is used as a standard treatment. Then each element—nitrogen, phosphoric acid, and potash—is varied in turn, while the other two are kept constant. The 4-12-4 fertilizer is also used at rates of 200, 600, and 800 pounds to the acre.

Cotton: For the fourteen-year period, (1927-40) the treatment of 12 tons of manure and 400 pounds of superphosphate to the acre produced the highest yield, 371 pounds of lint cotton to the acre or 160 pounds per acre more than the average of the plats which received no treatment and 72 pounds per acre more than the average of the five check plats which received 400 pounds of 4-12-4 commercial fertilizer to the acre. The treatment of 12 tons manure per acre produced the second greatest yield, 350 pounds of lint cotton to the acre.

Corn: For the same period of years the three treatments producing the greatest yields were: 12 tons manure and 400 pounds superphosphate, 33.7 bushels shelled corn to the acre; 12 tons manure, 31.6 bushels; and 8 tons manure, 31.2 bushels. The yield of the untreated plat was 23.2 bushels shelled corn to the acre, or 10.5 bushels per acre less than the highest yielding treatment.

Oats: During the same fourteen-year period, the three treatments producing the greatest yields of grain were: 800 pounds of 4-12-4 fertilizer, 34.2 bushels to the acre; 800 pounds of 4-12-4, 32.7 bushels; and 12 tons of manure, 31.5 bushels. The average yield of the five check plats which received 400 pounds of 4-12-4 commercial fertilizer to the acre was 28.7 bushels, and the untreated plat produced 21.5 bushels or 12.7 bushels per acre less than the highest yielding treatment.

Source of Nitrogen Test

This experiment is conducted to determine the relative merits of different nitrogenous fertilizers. Each fertilizer treatment is an application

of 400 pounds of 4-8-4, but the nitrogen in each fertilizer is supplied by different materials. In addition, two minor elements, Boron and Manganese, were used in the test this year. Of the nitrogenous materials tested over the period of years, including 1940, Nitrate of Soda produced the highest yield, 285 pounds of lint cotton to the acre and Sulphate of Ammonia produced a comparable yield of 272 pounds. Those plats receiving the minor elements, Boron and Manganeses, produced 203 and 136 pounds of lint cotton per acre respectively.

Cotton Variety Test

This test in 1940 consisted of 54 varieties randomized in six replications and of those varieties the three highest-yielding varieties were: Washington, 220 pounds of lint cotton to the acre; Stoneville 2B, 218 pounds; and D & P L 44-51, 217 pounds.

On the basis of comparable yields among those varieties that have been grown for 10 years or longer, the highest-yielding varieties are: Ferguson 406, 248 pounds of lint cotton to the acre; Startex 619, New Boykin and Sunshine, all three of which produced 233 pounds respectively. Startex 619 is a selection developed on the Main Station Farm and has consistently been a high producer. There are several varieties having yields greater than those named above, but most of those have only been in the test two or three years, and, therefore, are not yet ready to be considered among the better varieties. Stoneville 2B, Sunshine 74-2, and Mebane 804-50 are among the leading varieties which have not been grown for 10 years.

Spacing and Fertilizer Test With Cotton

The object of this test is to determine the differential response of spacing cotton at three degrees of soil fertility, or on poor, medium and fertile soils. These degrees of fertility are obtained by using unfertilized soil, and soil treated with 400 pounds and 800 pounds per acre of 4-8-4 fertilizer. Three spacings, single plants spaced at 12, 18, and 24 inches in 36-inch rows are used.

For the five-year period (1936-40) the 12-inch spacing produced a significantly higher yield on the poor soil than either the 18 or 24-inch spacing. On the medium and fertile soils the 12-inch spacing produced slightly higher yields than either the 18 or 24-inch spacing. Over the same period of years the 18-inch spacing produced slightly higher yields on the poor and medium soils than the 24-inch spacing, and significantly higher yields than the 24-inch spacing on the fertile soils.

Green Manure Test

The object of this test is to determine the amount of nitrogen made available by vetch as a green manure crop for cotton. The test consists of 30 plats, half of which are planted with vetch and the other half left

winter fallow. In the spring the hairy vetch is plowed under and all plats receive an application of commercial fertilizer, all nitrogen being withheld from those plats having vetch.

For the 4-year period, (1937-40) the average yield of the plats having vetch and an application of 500 pounds of 0-8-4 fertilizer was 284 pounds of lint cotton to the acre, as compared to 278 pounds for those plats having vetch and an application of 500 pounds of 4-8-4 fertilizer to the acre. This indicates that vetch adds more nitrogen to the soil than cotton can use.

Corn Variety and Spacing Test

Through the generous cooperation of Mr. George Chance of Bryan, Texas, this test was conducted on the Chance Plantation in the Brazos River bottoms, representing a large area of heavy, fertile, alluvial soils, admirably suited to cotton production. Corn yields in the Brazos bottoms, however, are seldom comparable to yields obtained from cotton.

There are 108 varieties in this test, including the better known and more popular commercial open-pollinated varieties, out-of-state commercial hybrids, cornbelt-Texas station hybrids, and hybrids developed by the Texas station. These varieties were replicated four times, twice at a spacing between plants of 15 inches and twice at a spacing between plants of 30 inches. Corn-belt hybrid seed producers recommend that hybrid corn be spaced closer than ordinary varieties, some even recommending only half as much space between plants as is usually allowed. These plantings at two different spacings were made to determine the effect of thick spacing.

As a group, the Texas station hybrids yielded 42.2 bushels per acre, and the commercial open-pollinated varieties 34.6 bushels per acre; the Texas hybrids giving an increase of 7.6 bushels, or 22 per cent, over the commercial open-pollinated varieties. Cornbelt-Texas Station hybrids, on the average, produced 40.7 bushels per acre, yielding 6.1 bushels, or 17.6 per cent, more than the commercial open-pollinated varieties. Commercial hybrids yielded an average of 35.9 bushels per acre, which was an increase of only 1.3 bushels, or 3.8 per cent over the commercial open-pollinated varieties.

Further, the highest yielding Texas Station hybrid produced 58.2 bushels per acre, and the highest yielding commercial open-pollinated variety 43.6 bushels per acre, a difference of 14.6 bushels, or 33.5 per cent in favor of the Texas hybrid. The best Cornbelt-Texas Station hybrid made a yield of 51.0 bushels per acre, which was an increase of 7.4 bushels or 16.9 per cent over the best commercial open-pollinated variety. The best commercial hybrid produced 46.4 bushels per acre, yielding only 2.8 bushels or 6.4 per cent more than the best commercial open-pollinated variety.

These results concerning the Texas hybrids are similar to those of 1939, when Texas hybrids, as a group, yielded 17 per cent more than the commercial open-pollinated varieties.

Thick planting at College Station with single stalks 15 inches in 3.5-foot rows resulted in a gain of 16.3 per cent for commercial varieties, 1.7 per cent for commercial hybrids, 18.0 per cent for Cornbelt-Texas Station hybrids, and 18.7 per cent for Texas Station hybrids.

Peanut Breeding

The seed produced from the cross of Macspan x Virginia Bunch was destroyed by rodents before the seed could be harvested during the winter of 1939-40. If it seems feasible to do so, this cross may be made at a future date.

Two strains of Florida peanuts were planted during 1940 but neither showed a great deal of promise.

Increase of Pure Seed

Included in the increased plantings of pure seed were Macspan peanuts, Startex 619 cotton, Honey June sweet corn, Texsun sweet corn, Surcropper Sugar sweet corn, and Ranger oats. All of this seed with the exception of Ranger oats are available to seedsmen and farmers throughout the State and in other States. It was decided to increase the Ranger oats for another year before making them available to the public.

Hybrid seed corn was produced for the first time on this station and has been made available to seedsmen and farmers. This hybrid known as Texas Hybrid No. 4 is a cross between Yellow Surcropper and the single cross (38-11 x KYS). The latter single cross is a cross of two inbred strains, the 38-11 coming from Indiana and the KYS from Kansas. Apparently there will be a ready demand for this hybrid which produced approximately 20% more than Yellow Surcropper.

J. E. Roberts.

PLANT PATHOLOGY AND PHYSIOLOGY

Cotton Root-Rot Investigations

(Including cooperative work with the Bureau of Plant Industry, U. S. Department of Agriculture)

Variation within the Root-Rot Fungus. Work on variation within *Phymatotrichum omnivorum* has been continued. Original differences between strains of the fungus isolated in different areas are being studied. and also differences arising during artificial culture. Continued cultivation has not resulted necessarily in "attenuation" of strains of *P. omnivorum*. A strain carried in culture for 11 years retains the original characteristics, including profuse production of sclerotia. It is slow in growth and in killing inoculated cotton plants in the laboratory and greenhouse. In general, with various strains, rate of growth in culture has correlated with rate of injury to cotton seedlings grown aseptically in agar slants, and

of larger cotton plants in the greenhouse. Long-continued passage through inoculated cotton seedlings has been found to produce less distinct changes in the vigor of different strains than were obtained by using different ages of fungous mat in transplanting.

Experimental Chemical Treatment of Trees and Shrubs with Root Rot. Further tests have been made of a chemical treatment for trees and shrubs with root rot, described in Progress Report No. 656. This method involves application around the plants of ammonium sulphate or ammonium phosphate, at 1 pound per 10 square feet of soil surface, along with three to four inches of water to avoid injury from the fertilizer. In tests carried out at two points in Texas during 1939 and 1940, the treatment frequently failed to save infected plants. The extent to which it prevented further spread of root rot could not be determined in most of these trials. Apparently successful results, in which diseased plants recovered at least temporarily, were obtained almost without exception only in tests in which the first application of ammonium sulphate was followed by a second application during the same season. This method is still under test and further trial will be required to determine whether it will be permanently useful under Texas conditions.

Walter N. Ezekiel.

The Root-Rot Test Nursery. Plants that were being tested for root-rot resistance at College Station were transplanted in 1940 to a new location at Substation No. 5, near Temple. Dry weather during the summer resulted in loss of many plants from drought and also in poor conditions for development of root rot. However, root rot was found during this season for the first time on young plants of the mimosa or silk-tree *(Albizzia julibrissin)*, and of *Prunus virens*, which is apparently fairly susceptible (rating probably ++). Among plants already reported as hosts of the disease, root rot killed plants of desert willow *(Chilopsis linearis)*, bird-of-paradise *(Poinciana gilliesii)*, redbud, mesquite, *Prunus mexicana*, *Tamarix articulata*, and American elm *(Ulmus americana)*.

Walter N. Ezekiel and C. H. Rogers.

Methods for Eradication of Root Rot in Nurseries and Orchards in Deep Sandy Soil. (In cooperation with Texas Forest Service.) This project, begun in 1940, has for its purpose development and testing of methods for eradication of root rot suitable for use in nurseries, orchards, and sites selected for such specialized uses, particularly in deep, sandy, approximately neutral to slightly acid soils. For these purposes, complete freedom from root rot is required rather than the partial control that is useful in general farming. Work was started during 1940 at the Indian Mound Forest Nursery, near Alto. The approximate areas infested with root rot were determined and charted by use of a cotton indicator crop. The efficacy of acidification of the soil with sulphur and

other possible methods for the eradication of root rot under these conditions will be tested. It is planned to attempt to limit infested areas by sorghum barriers.

Walter N. Ezekiel and Chris Nelson, Jr.

Inoculation of Cotton Plants in Sand Culture with P. omnivorum. Positive infection of 3-months old cotton plants, grown in the greenhouse in washed river sand with a complete nutrient solution was obtained in 91 per cent of the 75 plants inoculated. Typical wilting symptoms and death of the plants occurred in from 8 to 21 days after inoculation. The method of inoculation consisted in the placement of several sclerotia of the fungus in a small mound of Houston black clay soil around the stem of the plant at the surface of the sand. A supply of sclerotia for this inoculation work was obtained in pure cultures on Houston black clay soil with sorghum, corn, bean, cowpea, or cotton seed added as a nutrient material.

A. A. Dunlap.

Relation of Varieties and Fertilizers to Root Rot. Four early-maturing and four late-maturing varieties of cotton, in combination with four fertilizer treatments (12-8-0, 12-0-0, 0-8-0, and 0-0-0), were planted on heavily infested soils located in Burleson and Washington counties. The fertilizers were applied in the furrow at the rate of 600 pounds per acre. Analyses of the disease records for several dates showed that as a group the early varieties did not differ significantly from the late varieties in the amount of disease, although the early group outyielded the late group by a highly significant margin. Nitrogenous fertilizers depressed the percentage of disease significantly and resulted in highly significant increases in yield. Phosphate fertilizers were without significant effect on Houston black clay (Washington county) but on the less calcareous soils in Burleson county phosphate significantly increased both percentage disease and yield. These experiments will be continued.

Sulphur and Sulphur-Compost Additions to Root-Rot Infested Soils. Soil sulphur was applied in the furrow at the rate of 500, 1000, and 2000 pounds per acre on infested fields in Washington and Burleson counties. The applications were made in November and in March. There was no evidence of control of root rot in the cotton the following crop season. A mixture of soil sulphur and manure (1 to 3) was applied in the furrow at the rate of 500, 1000, and 2000 pounds per acre in March. Root-rot damage was slightly less severe in the rows receiving the heaviest sulphur-compost addition.

Lester M. Blank (Bur. Pl. Ind.)

Factors Influencing the Growth of P. omnivorum on Different Sources of Nitrogen. The study of the relative utilization of different types of inorganic nitrogen has been continued. Additional experiments have shown that the utilization of ammonium nitrogen results in a more acid reaction

in the media which may become a controlling factor in the growth of *P. omnivorum*. The utilization of nitrate nitrogen by the organism results in a drift toward a more alkaline reaction and usually does not retard growth. Experiments using carbonates and organic buffers have succeeded in showing that ammonium nitrogen and nitrate nitrogen are of essentially equal value in the nutrition of the organism when a favorable pH is maintained. No direct toxicity of ammonium has been observed. The influence of the balance existing between the essential actions on the utilization of nitrate nitrogen has been investigated.

P. J. Talley and Lester M. Blank (Bur. Pl. Ind.)

Carbohydrates and Nutritional Relationships of the Cotton Plant to Phymatotrichum Root Rot. Investigations have been undertaken during the past year on the relations between the susceptibility of cotton plants to Phymatotrichum root rot and the concentrations of growth-supporting materials in root tissues. This phase of the root-rot problem appears to be one that should be gone into rather thoroughly. Both greenhouse and field work along these lines are in progress.

Frank M. Eaton (Bur. Pl. Ind.) and Neil E. Rigler.

Chemical Investigations of Resistance of Plants to Phymatotrichum Root Rot. Work on the chemical nature, toxicity, and localization of inhibitory substances present in resistant plants, but lacking in susceptible ones, has been continued. The crystalline inhibitory compound found in the root bark of sour orange, *(Citrus aurantium)* was shown to have empirical formula $C_{14}H_{12}O_3$. It crystallizes in monoclinic tablets and has a melting point of 130.5° C. It yields upon alkaline fission a ketone and a phenol and contains two ethylenic double bonds and a methylenedioxy group. In many of its reactions it resembles a lactone, xanthyletin, which is found in the bark of prickly ash, *Zanthoxylum americanum* and whose structure has recently been established elsewhere, but is apparently not identical with it. This finding provides an interesting connection with the work in this laboratory on berberine, since berberine was also found in the root bark of *Z. americanum*. Experiments indicate that the inhibitory substance ($C_{14}H_{12}O_3$) exists in a free condition in the plant and does not require any enzymatic action for its liberation. From the root bark of the Meyer lemon, which, in contrast to certain other species of *C. limonia,* is resistant to root rot, was also isolated a crystalline inhibitory compound. This compound was shown to be identical with the compound from sour orange. It was likewise shown to be present in the fresh plant tissue in the free condition.

The study of the occurrence and localization of alkaloids in the native Amaryllidaceae was concluded. Besides lycorine, a second alkaloid of unknown identity was isolated from *Cooperia pedunculata*. The free base melts at 246° C. and yields a hydrochloride melting at 260°. It was found to contain one methoxyl and three hydroxyl groups. This alkaloid prevents the growth of *P. omnivorium* in culture at a concentration of 45 parts per

million and is present at a concentration of 50 parts per million in the fresh bulbs. Histochemical observations on thirteen species of Amaryllidaceae indicate the alkaloids of these species are mainly in the surface tissues of the bulbs and roots where they should form effective barriers to invasion by the hyphae of *P. omnivorum.*

In a quantative comparison of methods for sterilizing solutions of organic compounds used in culture media, the amount of loss of 33 typical compounds was determined under the following conditions: (1) autoclaving in presence of water, medium 70 (Ezekiel, Taubenhaus, and Fudge), and Czapek's solution (2) intermittent steaming in presence of water and (3) alcohol sterilization. It was found that autoclaving or intermittent steaming of most liquids, particularly the less soluble ones, gave rise to appreciable losses. There was little loss by vaporization of solids, particularly the more soluble ones. There was no appreciable hydrolysis of esters, glucosides, and amides nor oxidation of aldehydes and hydroquinine as long as the solution was approximately neutral. Except for the most volatile compounds, losses by alcohol sterilization were negligible. Where such losses did occur, they could be avoided by adding concentrated 50-95 per cent alcoholic solutions of the compounds directly to the medium.

Considerable time was spent in evaluating various methods for determining the betaine and choline content of cotton root bark but no completely satisfactory method was devised. A number of additional samples of cotton root bark were obtained and the study of the resistance of cotton plants grown under various conditions is being continued.

Neil E. Rigler and Glenn A. Greathouse (Bur. Pl. Ind.)

Other experiments on the control of cotton root rot, angular leaf spot of cotton, and on cotton seed treatments are included in the reports of Substation No. 5, Temple, and Substation No. 16, Iowa Park.

Cotton Fruiting Studies

Work has been continued in the greenhouse on the effects of varying moisture supplies upon the average number of bolls retained to maturity by the cotton plant. A comparison of different sizes of containers for growing cotton plants in sand culture showed that plants in the smallest containers (1-gal. jars) produced nearly as many (11.6) mature bolls as did those growing in larger (2-gal.) containers (13.4 bolls). In this series, the plants in the smaller jars were subjected to almost daily water stress as was shown by wilting symptoms between waterings. In a later series, all of the plants were grown in 2-gallon containers and occasionally certain ones were subjected to wilting. In this case, the plants which were not allowed to wilt produced 11.3 bolls per plant, whereas those which wilted occasionally produced only 7.3 bolls per plant. The application of indole acetic acid in lanolin to the stems of the late-season squares resulted in the retention of additional squares on the plant although the square so treated did not develop into a mature boll.

A. A. Dunlap.

Tomato Diseases

Studies on tomato wilt. Tomato wilt, as in previous years, was one of the most serious diseases of tomatoes in 1940 in the Yoakum-Hallettsville area, the losses ranging from a trace to almost complete failures. Even the wilt-resistant Marglobe was observed to be 90 to 100 per cent affected in several fields. Many varieties of tomatoes have been tested for resistance to wilt, but none has produced satisfactory crops in fields heavily infested with *Fusarium lycopersici.* Over 10,000 hybrids between Bohn and Tucker's wilt-immune stocks and commercial varieties were tested for resistance by the seedling method. Several desirable types were found to be immune or highly resistant to wilt.

A field test was conducted on the effect of different quantities of nitrogen, phosphorus, and potash on tomato wilt. In these studies, the prevalence or severity of tomato wilt was not materially affected by any of the fertilizers. Tomato wilt was so severe in this test that most of the plants were severely affected or dead before the first picking.

Spraying and dusting tomatoes. A number of insoluble copper materials were again used on tomatoes to find a substitute for Bordeaux mixture. Plants sprayed with Tennessee No. 34, Tri-Basic copper sulphate, Copper Hydro 40, basic copper sulphate, and sprayed or dusted with Cuprocide gave yields comparable to those of the checks. Bordeaux mixture 4-4-50 caused marked reduction in yields. No leaf diseases were present during the course of the experiments.

Studies on blossom-end rot and puff. In a test with 8 fertilizers differing in their nitrogen-phosphorus-potash ratios blossom-end rot varied with the amount of potash. It was more prevalent in plots fertilized with low-potash fertilizers than with high-potash fertilizers. Side dressing with nitrate of soda had a tendency to increase the amount of blossom-end rot. No correlation appeared to exist between the fertilizer and the prevalence of puff, however, puff was never severe at any time during the picking season.

The effect of the type of cultivation on the development of blossom-end rot and puff was determined in one test. The plots were cultivated in three ways (1) deep at first and then shallow at 7-10 day intervals, (2) deep all season at 7-10 day intervals, and (3) cultivated only to break crusts and kill weeds. Treatment number 3 gave the highest number of puffed fruits and also the highest yield of marketable fruits, but the yield was not significantly better than that of treatment number 1. Treatment number 2 gave the lowest number of puffed fruits and the lowest number of marketable fruits, also the highest number of fruits with blossom-end rot.

Seed treatment. In cooperation with the committee for Coordination in Cereal and Vegetable Seed Treatment Research of the American Phytopathological Society a test was conducted at Yoakum to determine the

relative effectiveness of some of the common seed treatments. The seeds had been treated with Semesan, Cuprocide, and zinc oxide at the recommended dosages. Beets, cabbage, cucumbers, peas, spinach, and tomatoes were used in the test. Only in the case of beets did any of the treatments give significantly better results than the checks. Semesan gave the greatest increase in emergence, with zinc oxide a close second. In another test in which Marglobe tomato seed was treated with DuBay 1286A (applied as a dust in excess) and New Improved Ceresan (1-1250 as a soak for 5 minutes), both materials gave promise as seed treatments.

A. L. Harrison.

Effect of chemicals on sclerotia of Sclerotium rolfsii. Various chemicals placed in tightly stoppered test tubes (30 ml.) containing viable sclerotia were tested to determine the amounts of the chemical and the length of exposure necessary to kill the sclerotia. Concentrations of from 5 to 15 drops of benzol, carbon bisulphide, carbon tetrachloride, formaldehyde, and toluol, placed so that the liquid did not touch the sclerotia, were lethal after an exposure of 17 hours. Ether tended to stimulate germination at 5 and 10 drop doses, but was lethal in 15-drop concentrations. One drop and 3 drops of chloropicrin were lethal after 2½ hours and 30 minutes exposure, respectively. In tests exposing sclerotia to confined vapors from measured quantities of chloropicrin, up to 3 cc per liter, it was observed that viability was reduced although some of the sclerotia germinated after 25 hours exposure.

Phenyl mercury nitrate (Phe-mer-nite) diluted to 1:10,000 with water was lethal to sclerotia of *S. rolfsii* after immersions of 60 seconds or longer. A 1:10,000 aqueous solution of sodium ethyl mercury thiosalicylate (Merthiolate) reduced the viability from 100 per cent to 15 per cent in 3 minutes and immersion of 5 minutes in a 1:1000 aqueous solution was lethal to the sclerotia. A 1:5000 dilution of this chemical in 50 per cent acetone was lethal to the sclerotia after 3 minutes immersion.

Breeding and testing tomatoes for Fusarium wilt resistance. A total of 64 strains (mostly F_2 crosses by Dr. P. A. Young) and 2 varieties involving approximately 2700 plants were tested for wilt resistance by the liquid culture method of inoculation. Flowers of selected resistant plants were selfed and the seed produced were saved for planting in test plots at Jacksonville in 1941.

G. E. Altstatt.

Results of experiments conducted at the Tomato Disease Laboratory, Jacksonville, are given under the report of Substation No. 11.

Diseases of Garlic and Other Vegetable Crops

In general the 1940 crop of garlic showed smaller disease losses than usual, probably because of the dry growing season. The practice of selecting good planting stock from the best garlic available at harvest was

followed and improved stands were obtained. Loss in storage was due principally to fungous dry rots (Aspergillus, Penicillium, and Fusarium spp.), with a small amount of bacterial soft rot.

Clove disinfection. Cloves treated prior to planting with mercury compounds such as Sanoseed, Semesan, and Phe-mer-nite produced better stands than the check lots, but final yields were not significantly greater. Several of the chemical disinfectants used, such as formaldehyde (1:16). cuprous oxide, and sulphur, proved harmful and caused a definite reduction in yield.

G. E. Altstatt.

Further experiments on the harvesting and drying of garlic and the effects of these treatments on disease control are described under the Division of Agricultural Engineering.

Histological study of spinach white rust. Spinach leaves in various stages of natural infection by *Albugo occidentalis* were fixed for microscopic study. Later the fixed material was embedded, sectioned, stained, and mounted permanently. The sections show a full range of stages of sexual and asexual reproduction of the fungus.

G. M. Watkins.

Diseases of Peanuts, Watermelons, and Cantaloupes

Investigations of peanut, watermelon, and muskmelon diseases were initiated at Stockdale and Yoakum. During 1940, however, unfavorable growing conditions and low incidence of disease prevented the obtaining of significant results. Over 100 varieties and selections of peanuts, 30 standard varieties and about 300 foreign introductions of cantaloupes, and 23 standard varieties and about 300 foreign introductions of watermelons were planted for the purpose of making selections for disease resistance (especially as regards southern blight of peanuts and downy mildew of cucurbits). Numerous single-plant selections of peanuts were made on the basis of yield. Spray and dust trials were carried out for control of diseases of all three crops, but in all cases diseases caused insignificant damage even on the check plants. Inoculation trials of MacSpan and Spanish peanuts with nitrogen-fixing bacteria gave no significant differences although there was a trend towards increased yield.

Glenn KenKnight.

Peach Diseases

Experiments with spring and summer sprays for peaches. Experimental sprays were applied to peach trees in the orchard at Substation No. 11 for the control of major disease pests. With one experimental spray schedule, wettable sulphur was included in each of six spray applications from March 19 to July 8. In the second schedule, sulphur was omitted from the first two sprays, but was used in the last four applications. Both spray treatments almost completely eliminated scab, and both resulted

in a large reduction of brown rot as compared with the controls. No appreciable advantage was gained from the use of wettable sulphur in peach sprays until the fruits were about one-half inch in diameter.

Another phase of the work concerned the use of zinc sulphate in the spray formula to reduce the injury to peach foliage caused by lead arsenate. Observations made throughout the growing season showed that the trees receiving zinc sulphate showed very little foliage injury from lead arsenate. The trees which received lead arsenate with no zinc sulphate added showed injury ranging from severe burning to almost defoliation, depending on the variety.

G. M. Watkins and H. F. Morris.

Rose Diseases

Histological studies of rose black spot. Leaves of the black spot-resistant Welch strain of *Rosa multiflora* and leaves of two susceptible varieties, Edel and Caledonia, were inoculated with spores of the black spot fungus, *Diplocarpon rosae*, and fixed, at definite intervals after inoculation, for cytological study. The extent of fungous invasion of the leaves will be studied in case of both the susceptible and resistant varieties.

G. M. Watkins and E. W. Lyle.

Other results of experimental work on the control of diseases of vegetables will be found in the reports of Substations Nos. 15 and 19; on the diseases of roses in the report of Substation No. 2; and on the diseases of rice in the report of Substation No. 4. Work on citrus diseases and chlorosis of various plants is described in the report of Substation No. 15.

SOIL SURVEY

(In cooperation with the Bureau of Plant Industry,
U. S. Department of Agriculture)

Detailed soil surveys were in progress in McLennan and Cherokee Counties during all of 1940 and in Uvalde County about four months of the year. A total of about 400,000 acres were surveyed in these counties. The surveys are made on a larger scale than formerly and are mostly on aerial photographs of a scale of approximately 4 inches to the mile or plane table surveys of a scale of 2 inches to the mile. The more detailed work now done permits a more exact delineation of smaller areas on the soil maps and the added data of soil phases, slope, and erosion features enable the use of the soil maps by various planning agencies. The system of soil classification and correlation conforms to the national standard, and the work is a part of the general scheme for making a complete inventory of the soils of the United States in accordance with the program sponsored and actively followed by the U. S. Department of Agriculture.

In some areas the Soil Conservation Service has cooperated by furnishing aerial photographs that are used as base maps, and these surveys are to be available to that Service for use in planning farm practices. Further cooperation with the Soil Conservation Service provided for inspection service for soil conservation surveys in the State in the same manner in which inspections are made for the soil surveys.

Reconnaissance soil surveys with a generalized report on the soils were made at the request of the committee of A. & M. College specialists appointed by the Governor to study methods for utilizing these farm lands to the best advantage.

Several days were spent with a party of specialists studying vegetation and soils in the Edwards Plateau and Central Basin with special attention to range conditions as affected by cedar growth and various methods of eradication of cedar.

The soils were examined on several proposed sites for the location of an experiment station in the West Cross Timbers, and maps and reports were submitted to the Director providing information regarding the suitability of the soils for use in research as representing this region.

Soil survey reports of Zavala and Kaufman Counties were issued by the U. S. Government Printing Office during the year.

Maps and reports prepared for land use planning committees were supervised in a general way to maintain a consistent correlation of the data in line with regular soil survey work. During the year generalized surveys made for this type of work were completed in about 15 counties.

Cherokee County

In February, 1939, the soil survey of Cherokee County was started and now about 29 per cent of the area has been surveyed. This county lies within the East Texas Timber Country and consists of a rolling dissected section of the Gulf Coastal Plain. The soils are mainly of loose sandy texture with heavy subsoils and are developed chiefly from unconsolidated noncalcareous sands and clays of Eocene formations. This is one of the leading truck farming counties of the State and the special crops produced include tomatoes, sweet potatoes, peanuts, and fruits. The soil survey will be especially valuable to the farmers in this diversified type of farming area in providing information to enable them to use the soils for crops to which they are best suited and to preserve, protect, and improve the soils of the county.

H. M. Smith, I. C. Mowery and W. T. Carter.

McLennan County

A soil survey was started of McLennan County, at the request of local citizens, in September, 1939, and 32 per cent of the county has been

surveyed. This important agricultural county is occupied by rolling prairie land of the Blackland Prairie and Grand Prairie with wide valleys of Brazos River and other streams. The soils have developed in a region of high rainfall and are largely prairie soils of rather varied characteristics. General farming, including the production of cotton, corn, feed crops, and small grains, is the prevailing type of agriculture in most parts of the county, but some of the stony and hilly parts of the Grand Prairie are used for ranching. Various truck crops are also produced in some sections.

E. H. Templin, A. L. Nabors, and W. T. Carter.

Uvalde County

Both in 1939, when the survey was started, and 1940 the Bureau of Plant Industry had a soil surveyor working in Uvalde County during the winter season before he was withdrawn to work in northern States. No State soil surveyors were assigned to the area, as they were working in other areas.

The southeastern part of Uvalde County lies in the smooth Rio Grande Plain, and the northern and western parts are occupied by the southern fringe of the Edwards Plateau. The northern part is a deeply dissected limestone area consisting largely of rough stony land and is devoted mainly to ranching. In the Rio Grande Plain section the surface is rather smooth and the soils are light-brown, brown, and dark-gray calcareous soils or red noncalcareous soils with small areas of smooth soils of alluvial materials. Small areas are in cultivation and some of the land is irrigated, as rainfall is low. The eastern part of the county lies at about the western limit of systematic dry farming.

C. A. Mogen and W. T. Carter.

FARM AND RANCH ECONOMICS

Regional Agricultural Adjustment

(In cooperation with the Bureau of Agricultural Economics, U. S. D. A.)

The purpose of this project is to develop information, by type-of-farming areas, to facilitate the planning of agricultural adjustments in each area. The work is divided into two phases:

1. The descriptive phase, in which the State has been divided into areas that have a high degree of similarity in soils and other physical features, as well as in the character of the agriculture and its related physical and economic problems. A general treatment of this phase was published in Bulletin No. 544, "A Description of the Agriculture and Type-of-Farming Areas in Texas," in 1937.

Further refinement of this material is the present objective of this project. The leaders of the project are cooperating with the Extension Service in the work of agricultural land use planning. Under this program an analysis is made in each county somewhat similar to the one made for

the State as a whole and reported in Bulletin No. 544. A reconnaissance soil survey is made of each county. This in turn is used by the county planning committee as a guide in dividing the county into type-of-farming areas. Information showing present land use and size and organization of farms in each area is developed from an analysis of data from the files of the Agricultural Adjustment Administration, special livestock surveys, and other related data. During the past year mimeographed reports were issued for thirteen counties in which work of this type was done.

2. The analytical phase, in which is developed detailed information pertaining to the production and production requirements of the alternative uses of land. This will permit an appraisal of present systems of farming and of land use changes which may be proposed from time to time. Work under way in the High Plains Wheat Area was continued, and plans were made for studies in two additional areas. Reports have been prepared for studies made in the High Plains Cotton Area, the Low Plains, and the North-Central Grazing Area. A report of a study completed in the Elm Creek watershed of the Black Prairie Area is being prepared.

Data pertaining to the costs of producing cotton in five areas in Texas were summarized and the results published in Progress Report No. 682. Featured in this report are the physical and financial costs of producing cotton, and the competitive relationship of cotton to other important crops grown in each area.

An analysis was made of mechanization and its relation to the cost of producing cotton. The results were published in Progress Report No. 684 and in the Proceedings of the Cotton Research Congress, Waco, Texas.

C. A. Bonnen and A. C. Magee; and B. H. Thibodeaux,
Bureau of Agricultural Economics.

Operating Costs and Financial Conditions of Gins in Texas

(In so far as this study deals with cooperative gin records for the seasons 1932-33 to 1935-36, the project is in cooperation with the Cooperative Division of the Farm Credit Administration.)

The analysis of the total costs of ginning and of the various items of cost has been completed. Much attention has been given to means of simplifying the application of the cost equations so as to make them usable to ginners. This has been accomplished through the computation of cost tables for total costs and the various items of cost and through the construction of alinement charts for total costs.

From the cost analysis, the next logical step is to explore the field of profits and losses of the ginning business. The transition may be made through the simple equation—: $\text{Gross Income} = \text{Cost} \pm \text{Profit}$

The problem is to make the proper substitutions so as to make the equation applicable to the ginning business. Suppose by way of illustra-

tion a Diesel gin with an investment of $20,000 in the Blackland Area be chosen. The gin income is the income per bale multiplied by the number of bales ginned. In this area, over a period of years, the gin income has averaged about $5.20 per bale. If V represents the number of bales ginned, then $5.20V represents the gin income. The cost equation representing the average cost of Diesel gins with an investment of $20,000 is: $\text{Average Cost} = \$2{,}198 + \$0.0887 \times 20{,}000 + \$1.37V$

The investment cost, $0.0887 × 20,000, or $1,774 added to the residual cost $2,198, or a total of $3,972 is the fixed cost of ginning. Through proper substitutions the above equation becomes: $\$5.20V = \$3{,}972 + \$1.37V \pm \text{Profit}$

By subtracting $1.37V from both sides, the equation becomes:

$$\$3.83V = \$3{,}972 \pm \text{Profit}$$

By dividing both sides by $3.83, the equation becomes:

$$V = \frac{\$3{,}972 \pm \text{Profit}}{\$3.83}$$

The $3.83 is the gin income per bale less the variable cost of ginning. Thus the equation in its final form above may be stated thus:

$$\text{Volume of Ginning} = \frac{\text{Fixed Cost} \pm \text{Profit}}{\text{Gin Income Per Bale} - \text{Variable Cost Per Bale}}$$

This equation is extremely useful in finding the volume needed under a variety of circumstances. Several of these are listed below.

1. To yield a specific net profit. Suppose the owner of a $20,000 Diesel plant with an income of $5.20 per bale wishes to know the volume needed to earn 10 per cent on the investment.

$$\text{Volume of Ginning} = \frac{\$3{,}972 + \$2{,}000}{\$5.20 - \$1.37}$$

2. To determine the "break even" volume. Suppose the problem is to find the "break even" volume of a $20,000 Diesel gin with a gin income of $5.20 per bale.

$$\text{Volume of Ginning} = \frac{\$3{,}972}{\$5.20 - \$1.37}$$

3. To ascertain the volume required for a standard cost per bale. Suppose the problem is to find the volume needed by a $20,000 Diesel gin at a standard cost of $3.50 per bale.

$$\text{Volume of Ginning} = \frac{\$3{,}972}{\$3.50 - \$1.37}$$

4. To determine the increase in volume needed to yield the same total net profit but with a lowered gin income per bale. The gin income per bale may be lowered by such means as: reducing the gin toll; narrowing the margin of profit on bagging and ties and cottonseed; or paying above the market for cotton purchased from patrons. A Diesel gin of average

efficiency with an investment of $20,000 and a gin income of $5.20 per bale earns a net profit of $1,773 at a volume of 1,500 bales. Suppose the problem is to find the volume needed to earn the same profit but with a reduction of $0.50 a bale in the gin income.

$$\text{Volume of Ginning} = \frac{\$3{,}972 + \$1{,}773}{\$5.20 - (\$1.37 + \$0.50)}$$

W. E. Paulson and L. P. Gabbard.

A Study of the Marketing of Turkeys in Texas

(In cooperation with the General Education Board; this cooperation ended June 15, 1940.)

Data on the sales by growers in the Thanksgiving and Christmas markets of 1939 were obtained on a total of 56,082 turkeys. Of this number, 16,551 were No. 1 toms; 19,431 No. 1 hens; 13,847 No. 1 toms and hens mixed; 2,002 No. 2 toms; 2,731 No. 2 hens; and 1,520 No. 2 toms and hens mixed.

On these sales in the local markets, such information was obtained as: the name of the market; the date of the sale; the grade of the lot; the sex; the number of birds; the total weight; and the total returns to the grower.

The average weight on No. 1 and No. 2 birds were: 16.0 and 11.9 pounds for toms, and 12.8 and 9.9 pounds for hens in the Thanksgiving market; and 15.9 and 11.0 pounds for toms and 12.8 and 9.0 pounds for hens in the Christmas market. These weight distinctions are important in that grading in the Texas markets is principally a matter of weight per bird. The specific weight separating No. 1 from No. 2 birds may vary somewhat from market to market. In general, however, toms above 12 to 14 pounds are graded as No. 1; and hens above 8 to 9 pounds are graded as No. 1. The No. 2 lots, in addition to the underweights, include the crooked breasted birds.

In the Thanksgiving market, the average prices per pound received by growers were: 13.5 and 13.8 cents for No. 1 toms and hens; and 9.3 and 9.9 cents for No. 2 toms and hens. In the Christmas market, the average prices per pound received were: 10.5 and 12.1 cents for No. 1 toms and hens; and 6.8 and 7.1 cents for No. 2 toms and hens. While the average discount on No. 2 birds in the Thanksgiving market was 4.1 cents per pound, the discounts ranged from 2.6 to 6.2 cents in the different counties. It is to be noted especially that while No. 1 hens commanded a premium of 0.3 cents a pound over No. 1 toms in the Thanksgiving market, No. 1 hens commanded a premium of 1.6 cents a pound over No. 1 toms in the Christmas market. During the season 1940, buyers in the local markets of Texas quite generally paid a premium of 2 cents a pound on hens. This means that a premium is being placed on the lighter birds. This raises the question as to the justification of the Texas grading procedure which places an arbitrary weight per bird as separating No. 1 birds from No. 2.

According to the reports received, 92.3 per cent of the turkeys in the Thanksgiving market graded No. 1 and 80.5 per cent in the Christmas market graded No. 1. It is a question, however, whether these reports truly reflected the relative importance of No. 1 and No. 2 turkeys in these two marketing periods.

W. E. Paulson.

Factors Affecting the Equitable Assessment of Rural and Urban Property In Texas

(In cooperation with the Bureau of Agricultural Economics, U. S. D. A.)

During the past year the Experiment Station, in cooperation with the Bureau of Agricultural Economics, U. S. Department of Agriculture, has made tax studies in Young and San Saba Counties at the request of and in close cooperation with the county land use planning committees of these counties. The chief objective of this research is to develop basic data regarding the comparability of assessments for tax purposes among the different groups of properties, as well as between individual properties in a given class of property.

The following preliminary reports have been published in mimeographed form and made available to and discussed with the local committees in Young County:

1. Assessment of Farm and Ranch Lands and Intangible Property.
2. Assessment of Urban Property.
3. Assessment of Utility and Oil Properties.

The study of the assessment of farm and ranch lands and intangible property revealed that real estate bears a disproportionately heavy share of the total tax load, and that there is a wide discrepancy in the ratios of assessment between individual farm properties and among the type-of-farming areas of the county. An analysis of probate records shows that almost 38 per cent of the total taxable wealth is intangible property, which constitutes less than 4 per cent of the total property taxed.

The regressive tendency of assessments is indicated by the fact that the average assessment ratio of farms valued at less than $1,000 was 67 per cent of the sales value and 64 per cent of the appraised value. In the case of farms valued at $5,000 and over the ratio was approximately 36 per cent of the sales value and 40 per cent of the appraised value.

Farm tax delinquency constitutes further evidence of the disproportionately heavy burden of taxes borne by farm and ranch lands. A compilation of taxes delinquent on lands and personal property secured by lands revealed that this property constitutes 36 per cent of the total property taxed but accounts for only 11 per cent of the taxes delinquent for state, county, and common school purposes.

In the main, the same inequalities and tendencies were found to exist in city properties as in the farm and ranch properties, with the exception that the amount of delinquency was considerably higher on city property than on farm and ranch lands.

The study of the assessment of utility and oil properties revealed that approximately 36 per cent of the total assessed valuation of the county was composed of these types of property. The utility property constituted about 8 per cent of the valuation and the oil properties amounted to 28 per cent of the assessed valuation.

One of the important facts revealed by the utility and oil study was that the county assessor's office does not maintain adequate maps or up to date and complete inventories of the property involved. Thus the assessor's office is forced to accept the renditions submitted or to make arbitrary changes in them. On the other hand, it was found that a considerable amount of useful information is obtainable from the various state departments in Austin, particularly the Gas Utilities Division of the Railroad Commission. Unfortunately this information is not organized for the purpose of assisting in the valuation of properties, and, therefore, each person desiring to use it must adapt it to his purposes.

While it is true that the county assessor's office and the commissioners' court has sufficient authority to improve the assessment procedure and to equalize the assessment of all types of property, it is believed that the assessment of public utility and oil properties can best be improved through the delegation of authority to a state agency. Such an agency should be required to obtain and organize the information necessary to assess utility and oil properties throughout the state. Such information might then be made available to all local assessors, or the agency itself might be given the responsibility of assessing such property.

Field work in San Saba County has been completed in the farm and ranch land and intangible property and in the city property phases of the study and the data are being analyzed.

In the study of the trend of taxes on farm and ranch real estate, a considerable amount of data for the years 1939 and 1940 was assembled during the year, but it has not been compiled as yet.

L. P. Gabbard and H. C. Bradshaw

Factors Affecting the Collection and Expenditure of Taxation Revenues in Texas

The purpose of this project is to discover the various means by which improved management of state and local finances may reduce farm taxes or make them more equitable. In carrying out this purpose, one of the first procedures which has been investigated is that of county budgeting. The following comments are based on a manuscript completed during the past year.

The majority of county officials agree that the uniform budget law permits effective budgeting of local resources. The results obtained are, therefore, dependent upon the care exercised by local officials in administering the law. Although the form on which most budgets are prepared was designed by the State Comptroller, uniformity has not been achieved as between different counties. This is true because each county official has had to make his own interpretation of the terminology involved. Because of the difficulty occasioned by this lack of agreement, a suggested outline of the manner in which the essential items of a budget should be handled has been developed through conferences with budget officers over the state.

Despite the fact that the budget documents have many deficiencies, the counties are making a good record in terms of living within their available resources. An analysis of 231 current funds for the budget year 1935 reveals that 83 per cent of these funds spent less than their available resources, that is, balances plus receipts. The 17 per cent of the funds remaining spent more than they had available. An analysis of 100 current funds in 26 of the 60 counties for the budget year 1939 reveals that the results obtained in 1935 were continued during the four year period 1936-1939, inclusive. In the case of these 26 counties, the current funds on a cash basis increased from 67 to 82 per cent between 1935 and 1939. During the same period certain other deficits which were not retired were substantially reduced. These results indicate that officials are making real efforts to apply budgeting principles to government.

Based on this study the following suggestions are made for the improvement of budgeting. In the first place an effort should be made to reach substantial agreement concerning the content and arrangement of the budgets. This would make the preparation of the budget more understandable and helpful to officials and the public. In the second place a manual of instructions should be prepared in order to demonstrate the manner of estimating and presenting the information essential to a budget. In the third place, a field force should be provided in the State Comptroller's office. This field force should be charged with the duty of determining the best budgeting methods now used by the counties, and the further duty of passing these methods on to less fortunate county officials.

During the past year, Progress Report No. 705 on the cost of delinquent tax contracts in Texas counties was mimeographed and released.

H. C. Bradshaw and L. P. Gabbard.

The Economic Significance of Different Farm Leasing Systems in Texas

(In cooperation with the Bureau of Agricultural Economics, U.S.D.A.)

The many adjustments in the techniques of farming in recent years have been accompanied by certain maladjustments in leasing systems and landowner-tenant relations. The aims of this project are to develop a better understanding of the problems of land tenure and to devise methods of adapting farm rental agreements to modern agricultural conditions.

Although the State as a whole has not been affected equally by these adjustments, the trends observed in the last Annual Report have, in general, continued at the same rate. These are:

1. Increased mechanization in farming operations.
2. Increases in the average size of the farm unit.
3. A substantial reduction in the number of farm tenants, through shifts to a wage labor status and outright displacement.
4. A greatly stimulated rural-to-urban migration rate.
5. A changing combination-of-enterprises pattern, chiefly in the direction of greater emphasis upon livestock production and feed crops and less upon cash crops.
6. Further modification of rental rates on tenant operated farms, with an increase in cash rents for pasture and feed land.

A study of the types of tenants, their socio-economic status, and their geographical distribution was conducted in cooperation with the Bureau of Agricultural Economics, U. S. Department of Agriculture, during the year. More than 3,000 farmer questionnaires, together with Census data and related material, were used as a basis for delineating type-of-tenancy areas in the State. A report identifying and describing these areas is now in manuscript form.

A land tenure committee composed of representatives from each of the Southwestern States was established under the sponsorship of the Farm Foundation in December 1939. This group is directing its activities toward informal cooperation in the study of land tenure problems having regional implications. Four specific projects were selected for Texas as our contribution to the advancement of research in the region. The first of these, involving a determination of the significant differences between the various tenure groups, has been initiated in Kaufman County. This work will be closely integrated with the county land use planning program.

Joe R. Motheral and L. P. Gabbard.

BOTANY

The identity and distribution of native vegetation is of considerable importance to the study of agricultural problems. Vegetation is an important item in furnishing feed for livestock. Some species of vegetation when eaten are harmful to livestock. Many species have value as honey producers. Plants also act as carriers of plant diseases and in this way have an important relation to agriculture.

The study of native vegetation in relation to livestock industry is centered around the work at the Ranch Experiment Station. It involves principally the occurrence of species which make up the range feed values and the occurrence of species which are harmful to livestock or have low

range feed values. The study of the sequence of the different species also widens our knowledge of the extent to which these may affect range feed values.

The work in connection with honey plants is centered at the Apicultural Research Laboratory near San Antonio and is reported under the Division of Apiculture.

The study of vegetation as carriers of plant diseases is centered at Substation No. 5, Temple, primarily in connection with cotton root rot disease work. Some additional work with plants as weed pests is being carried at the Winter Garden Station and at the Apicultural Research Laboratory.

SWINE HUSBANDRY

Relationship of Genetic Factors to Vitamin A Requirements in Mammals

(In cooperation with School of Agriculture, A. & M. College of Texas)

Two inbred lines have been found to differ significantly in the time required to show symptoms of vitamin A deficiency when placed on an A-free ration under standardized conditions.

Several groups of female rats have been fed on a ration which produced definite symptoms of A-deficiency in swine and which caused eyeless litters to be born to females fed this ration some time prior to and for a short time after mating. A high percentage of sterility was observed among the female rats fed this ration. No proof that this ration will produce eyeless rats when fed to females of a genetically normal-eyed strain has been obtained.

Attempts to discover some of the environmental factors affecting the expression of genetic factors producing "eyeless" rats revealed a very significant difference between the time required for death of these rats and those of another strain of hooded rats maintained in the laboratory, when the two strains were placed on a B^1-free ration. The eyeless strain lived, on the average, about 22 per cent longer than the hooded strain.

J. H. Quisenberry, F. Hale.

Cottonseed Meal as a Feed in Swine Nutrition

The object of this study is to determine the causes which limit the use of cottonseed meal in rations for swine. To establish whether the presence of a toxic substance is a major or minor factor and to conduct detailed studies of the chemical and biological properties of any toxic material which cottonseed and cottonseed meal may contain.

This year ethanolic extracts of the petrolic ether extracts of cottonseed kernels were prepared for rat-feeding tests. A water soluble crystalline compound was also isolated from the petrolic ether extract for rat feeding.

The results from this work must await further study before drawing conclusions.

Three groups of five pigs each (fed individually) were fed in a 90-day test to study the relative value of (1) expeller cottonseed meal cooked under steam pressure, (2) expeller meal cooked under atmospheric pressure, and (3) hydraulic cottonseed meal. These three types of meal were prepared by a Memphis, Tennessee mill. The ration used contained 63 pounds ground kafir, 15 pounds cottonseed meal, 10 pounds ground oats, 10 pounds wheat gray shorts, 1½ pounds bone meal, ½ pound salt. The pigs averaged 67 pounds initial weight. Two ounces of cod liver oil were given each pig every ten days throughout the test. The average daily gains of the pigs were 1.45 pounds for the hydraulic meal, 1.43 pounds for the atmospheric pressure cooked expeller, and 1.36 pounds for the steam pressure cooked expeller.

C. W. McMath and F. Hale.

Quantitative Requirements of Vitamin A for Pigs

Five gilts fed a ration containing 100 micrograms of carotene in the form of alfalfa leaf meal per 100 grams of feed farrowed normal pigs for the first litter, but the pigs of second consecutive litters were extremely weak. Over half of the pigs were too weak to nurse. The weak pigs, after they were given high potency cod liver oil, gained strength rapidly. These results show that rations for brood sows during the gestation period need greater amounts of vitamin A potency than were furnished in this test.

Four groups of four pigs each were fed rations containing varying amounts of vitamin A potency from June 14 to September 20, 1940. The pigs in each group were fed individually. Group 1 received 35, group 2, 70, group 3, 100, and group 4, 1000 micrograms of carotene per 100 grams of feed furnished by alfalfa leaf meal. The pigs in each group were from sows that had been on 100 vitamin A units during the gestation and lactation period. At the beginning of the test, three pigs were killed and their livers assayed for vitamin A. Only 2.0 parts per million of spectro vitamin A was found in the livers. The results of this test indicate that 100 micrograms of carotene per 100 grams of feed is approximately the minimum for growing pigs. All of the pigs getting 35 units show avitaminosis A symptoms. Two of the pigs receiving 70 micrograms of carotene showed symptoms of vitamin A deficiency. This study is being continued.

F. Hale and G. S. Fraps.

Calcium Requirements of Pigs Fed Rations Balanced with Cottonseed Meal

The object of this study is to determine the optimum amount of calcium required in rations for growing and fattening pigs where cottonseed meal is used as the protein supplement. The two rations used this year contained 1 per cent and 1½ per cent of limestone, respectively. The pigs fed that ration with 1 per cent limestone made .14 pounds greater daily gains per

pig and required 15 pounds less feed per 100 pounds gain than did the pigs fed the ration with 1½ per cent limestone. Previous years work show that less than one per cent of limestone in cottonseed meal rations is insufficient for growing and fattening pigs.

Sudan Grass Pasture for Fattening Hogs

The test with Sudan grass pasture this year resulted in a saving of 468 pounds of protein supplement per acre of Sudan pasture with 74-pound pigs fed in individual pasture lots for 90 days. The grain and protein supplement were self-fed, free choice. A mixture of 45 pounds tankage, 45 pounds cottonseed meal, and 10 pounds of alfalfa leaf meal was used for the protein supplement. The grain used was threshed whole kafir. The average final weight of the pigs on Sudan pasture was 220.4 pounds, and for the dry-lot-fed pigs, 223.7 pounds at the close of the 90-day test. The pigs were six months old at the close of the test period.

F. Hale.

Concrete Hog Wallows for Fattening Hogs

The object of this test is to determine the value of sanitary hog wallows for fattening hogs. Twenty pigs were used in the test this year. Ten pigs with access to individual pens with a hog wallow were compared with ten pigs fed in individual pens without access to a hog wallow. The pigs averaged 65 pounds at the beginning of the 90-day test. At the close of the test, the pigs with access to the wallow averaged 235.4 pounds, and the pigs without access to the wallow averaged 208.7 pounds. The pigs in the wallow lots gained as much in 76 days as the pigs gained, without the wallow, in 90 days. 376.4 pounds feed per 100 pounds of gain was required for the pigs with and 378.8 pounds for the pigs without the wallow. These tests were conducted during the months of June, July, and August, with an average temperature of 81.6 degrees F.

F. Hale.

DAIRY HUSBANDRY

The Quantitative Requirements of Vitamin A for Dairy Cattle

This project has been continued as outlined in previous reports. Three groups composed of six heifers each have been fed on levels of 1000, 2000, and 2500 micrograms of crude carotene per 100 pounds liveweight since approximately five months of age. During the year two animals died from the group fed 1000 micrograms of carotene. All of the animals in this group have shown night blindness to some degree throughout the year and one of the animals that died was completely day blind for several months before death. Three of the six heifers comprising the group fed the lower level of carotene have produced one calf each (born dead), one other aborted and the other two have never conceived. All of the animals in this group have shown definite physical symptoms of vitamin A deficiency, such as intermittent periods of loss of appetite, unsteady gait,

swelling of joints, and general emaciated appearance. These results indi cate that 1000 micrograms of carotene per 100 pounds liveweight is no enough carotene to maintain dairy heifers, even without considering thei requirements for milk production and reproduction. Although the genera health and well being of animals fed the two higher levels of carotene has been much better than for the group which received only 1000 micro grams of carotene, milk production and breeding behavior have not beer 50 per cent of normal. Heifers in their second lactation have not milked as well as in the first lactation. Results from the standpoint of milk production indicate that the carotene requirements of dairy cows are considerably higher than 2500 micrograms of crude carotene per 100 pounds liveweight of the animals.

Continuing the investigation to ascertain the effect of a deficiency of carotene on milk yield during a lactation, the results of three separate experiments are available and will soon be published as a Station bulletin. The average results of two experiments comparing rations containing 15,000 micrograms of carotene vs. 1,500 micrograms of carotene showed 9.4 per cent more milk produced on the higher carotene level. Perhaps some of this greater milk production was the result of additional energy and protein supplied to the ration by the greater quantities of alfalfa leaf meal fed to furnish the additional carotene. To answer this another experiment was conducted comparing alfalfa leaf meal and carotene extract dissolved in Wesson oil as sources of vitamin A for milk cows. In this experiment 2.7 per cent more milk was produced from the alfalfa leaf meal. This would indicate that of the 9.4 per cent greater milk production in the first two experiments only 6.7 per cent could be attributed to the greater amounts of carotene supplied.

O. C. Copeland and G. S. Fraps.

New born calves born dead as well as cows which died in our vitamin A studies have been submitted to the Division of Veterinary Science for pathological studies.

H. Schmidt and O. C. Copeland.

Bang's Bacillus Disease (Bovine Infectious Abortion)

The dairy herd of the Feeding and Breeding Station has remained free of Bang's disease during the year. There was an average of 1.39 services required for each calf born during the year, excluding calves born from cows being used in the study of the vitamin A requirements of dairy cattle. Out of 57 cows producing a calf during the year, 43 conceived from only one service, eight required two services, four required three services and two required four services for conception. There was one abortion during the year but it was not caused by Bang's disease since the cow reacted negative to the blood test for this disease. The average milk production for the herd this year was 2,538 pounds more than in 1937 the year Bang's disease was eliminated from the herd.

H. Schmidt and O. C. Copeland.

Dehydrated Sweet Potato Meal vs. Ground Shelled Corn for Lactating Dairy Cows

This project has only recently been started with the object of ascertaining the value of dehydrated sweet potato meal as a concentrate feed for milking cows. This feed material is somewhat similar to shelled corn in chemical composition and is being compared with ground shelled corn in this experiment. It has been determined that the sweet potato meal is quite palatable to dairy cows but the experiment has not progressed far enough to obtain information on its value for milk production.

O. C. Copeland.

Milk Substitute vs. Skim Milk for Dairy Calves

(In cooperation with School of Agriculture, A. & M. College of Texas)

A milk substitute containing approximately 29.5 per cent digestible protein is being compared with skim milk in the ration of young dairy calves. Thirty-eight calves have been raised to weaning age in this experiment, 19 of which were fed the milk substitute. Jersey calves fed the milk substitute were 97.3 per cent of normal weight and 98.3 per cent of normal height at weaning age. Holstein calves fed the milk substitute were 95.2 per cent of normal weight and 98.2 per cent of normal height at weaning age. The milk substitute proved to be equally as palatable as skim milk for all calves between the ages of one month when the milk substitute feeding was started and six months of age when the calves were weaned. Based on current feed prices of the feeds used in the milk substitute and of dried skim milk powder the average feed costs of the calves fed the milk substitute was 65.7 per cent of the feed costs of the calves fed skim milk.

O. C. Copeland and A. L. Darnell.

Legume vs. Non Legume Dry Roughages for Dairy Cattle

(In cooperation with School of Agriculture, A. & M. College of Texas, and Texas Cottonseed Crusher's Association)

This project was recently started with the object of comparing alfalfa hay with some of the more common non-legume roughages for lactating dairy cows. The first experiment involves a comparison of alfalfa hay with sorghum hay. In this experiment additional supplements of protein, calcium, and carotene are added to the sorghum hay ration to balance the extra protein, calcium, and carotene furnished by the alfalfa hay. The experiment has not progressed far enough to present definite results.

C. N. Shepardson, A. L. Darnell, and O. C. Copeland.

Methods of Manufacture and Other Factors Affecting the Quality of Butter

The survey of butter plants in the state is nearly completed. A examination of the records for the past two years indicate that the harde butter was produced in October, November, December, and January, a the softest in June, July, and August. Gummy butter may or may not hard in body. It occurred most commonly in August and Septembe Churnings will be made in the laboratory to determine the effects manufacturing methods on the hardness and gumminess of butter.

F. E. Hanson and C. N. Shepardson.

The Effect of Various Temperature Exposures on the Quality of Southern Short Cure Cheddar Cheese

In order to be able to analyze a large number of cheese samples, it w necessary to develop faster methods of analysis. Hence, micro metho for preparing the samples and for determining the various protein fractio were developed. In order to obtain cheese of more uniform moisture conte the oil-method has been improved so that the moisture content of t curd can be determined quickly during various stages of manufacturin The rate of curing as determined by analytical procedures and by gradi can be increased by using higher curing temperatures. Temperatur being used are 45°, 60°, 70°, and 80° F. The most desirable temperatu has not been definitely determined yet.

F. E. Hanson and C. N. Shepardson.

Variations in Normal Composition of Milk Produced in Texas

(In cooperation with School of Agriculture, A. & M. College of Texas)

During the past year work on this project has involved further refin ments of some of the analytical procedures, and a continuation of the mi analyses begun in December, 1939. Principal changes in the methods analysis include (1) The substitution of the A. O. A. C. Official Munso Walker method for lactose in place of the picric acid method, (2) Certa improvements in the equipment and procedure of the Micro-Kjelda analysis, (3) Discontinuation of the chloride determination.

The following table summarizes the results to date, the data sho being twelve-month averages for the constituents indicated:

	College Holsteins	College Jerseys	Herd* No. 1	Herd* No. 2
Fat	3.43%	5.11%	4.46	3.64
Protein	3.26	3.81	3.34	4.92
Lactose	4.44	4.57	4.63	4.73
Ash	.73	.77	.74	.76
Total solids	11.78	14.15	13.15	14.07

*Herds owned by local dairyman.

Results to date indicate the advisability of extending the scope of this problem to include samples from a wider area and this is contemplated during the coming year.

T. R. Freeman and C. N. Shepardson.

POULTRY HUSBANDRY

Protein Requirements of Chicks

One experiment was conducted in which 14, 16, 18, and 20 per cent protein was fed in triplicate to three lots of growing chicks for a period of ten weeks. Equal amounts of vacuum dried fish meal, 65 per cent protein, cottonseed meal, and soybean oil meal were used to make up the protein concentrate portion of the ration. At six weeks of age, the feed of the first four lots was changed. The 14 per cent protein group was increased to 20 per cent protein; the feed of the 16 and 18 per cent protein groups was decreased to 14 per cent protein, and the feed of the 20 per cent protein group was decreased to 16 per cent protein. At eight weeks of age, this procedure was used on the second four groups. The remaining four groups were fed 14, 16, 18, and 20 per cent protein throughout the experimental period, which was of ten weeks duration. From the data obtained in this experiment it appears that growing chicks should be fed a ration containing approximately 20 per cent protein for the first six weeks. After this time it is possible that this level of protein may be decreased to 16 per cent.

This project is conducted in cooperation with the Feed Control Service.

F. D. Fuller, R. M. Sherwood, J. R. Couch.

Carotene Requirements of Growing Chickens

In an experiment in cooperation with the Division of Chemistry, growing chicks were fed 200, 400, and 600 micrograms of carotene from dehydrated alfalfa leaf meal from hatching time until they were approximately five and one-half months of age. From the data of this experiment, the carotene requirements of growing chickens for maximum growth and lowest mortality is between 200 and 400 micrograms of carotene per 100 grams of feed. This is somewhat higher than that previously reported by the Divisions of Poultry Husbandry and Chemistry.

R. M. Sherwood, G. S. Fraps.

Varying Amounts of Vitamin D Fed with a High Level of Manganese

Groups of hens that had finished their first laying year and groups of pullets that were just beginning to lay were used in this study in cooperation with the Division of Chemistry. A basal ration containing 204 parts of manganese per million parts of feed was used. The groups of hens and groups of pullets were fed the basal ration supplemented with 27, 51, and 102 A. O. A. C. chick units of vitamin D per 100 grams of feed. The birds were not allowed access to direct sunlight.

The hens in this test required approximately 102 A. O. A. C. chick units of vitamin D per 100 grams of feed for satisfactory egg production and high hatchability. The pullets in this test required approximately 51 A. O. A. C. chick units of vitamin D for satisfactory egg production and high hatchability.

J. R. Couch, G. S. Fraps, R. M. Sherwood.

Effect of Sulphur on the Vitamin D Requirements of Chickens

In experiments conducted in cooperation with the Division of Chemistry from 128 to 384 A. O. A. C. chick units of Vitamin D from fortified fish liver oil were fed with two and one-half per cent dusting sulphur. Chicks receiving this amount of sulphur required approximately 160 A. O. A. C. chick units of vitamin D per 100 grams of ration for satisfactory growth, calcification of the bones, and maximum utilization of the feed. Chicks in these experiments were not fed sulphur until they were two weeks of age.

In another experiment, chicks were fed two and one-half per cent dusting sulphur after they were two weeks of age and were given access to direct sunlight for ½, 1, 1½, 2, 2½, and 3 hours per week between 10 a. m. and 2 p. m. It was found that chicks fed 2½ per cent of dusting sulphur received sufficient exposure from one hour of direct sunlight per week to meet their vitamin D requirements for satisfactory growth, calcification of the bones, and maximum utilization of the feed.

Rickets, which is due to a lack of vitamin D, was not encountered in either of the above experiments.

R. M. Sherwood, G. S. Fraps, J. R. Couch, L. E. James.

Effect of Varying Amounts of Different Types of Sulphur on Chick Growth

In a ration with adequate amounts of vitamin D 2.5, 3, 4, and 5 per cent of flowers of sulphur and the same quantities of dusting sulphur, which is ground so that 98 per cent of it will pass through a 325 mesh screen were fed with 256 A. O. A. C. chick units of vitamin D per 100 grams of ration in an effort to determine the effect of different amounts of these two types of sulphur on chick growth. It was found that the growth of chicks fed 5 per cent of either of the above types of sulphur was retarded at ten weeks of age. Four per cent of these sulphurs did not appear to seriously effect the growth of chicks up to ten weeks of age.

R. M. Sherwood, J. R. Couch, L. E. James.

Manganese as a Supplement to Laying Rations

Hens that had finished their first laying year and pullets that were just beginning to lay were used in this study. The hens were selected on the basis of high hatchability and low embryonic mortality of their fertile eggs. The pullets were selected on the basis of high hatchability and low embryonic mortality in the fertile eggs of their dams.

The basal ration contained approximately 14 parts of manganese per million parts of feed and 102 A. O. A. C. chick units of vitamin D per 100 grams of ration. Groups of pullets and hens were fed the basal ration unsupplemented and supplemented with 30 and 60 parts of manganese per million parts of feed. The birds were not allowed access to direct sunlight. In order to limit the manganese consumption of the hens litter was not used on the floor.

The data suggests that a deficiency of manganese may affect hens more seriously than it does pullets. The hens used in this study required 44 parts of manganese per million parts of feed for satisfactory egg production and hatchability. The pullets required 14 parts of manganese per million parts of feed for satisfactory egg production and 44 parts of manganese per million parts of feed for high hatchability. The embryonic abnormality known as chondrodystrophy, which has been attributed to a lack of manganese in the feed of laying birds, was not encountered to any appreciable extent even in the low manganese ration. This is attributed to the fact that the birds were selected from families in which this abnormality was not prone to occur. From these data it is suggested that chondrodystrophy may be an inherited characteristic which expresses itself only when the hen is fed rations low in manganese.

R. M. Sherwood, G. S. Fraps, J. R. Couch, L. E. James.

Effect of Varying Amounts of Carotene from Alfalfa on the Storage of Vitamin A in the Liver

Chicks were fed a basal ration in cooperation with the Division of Chemistry planned to contain all dietary essentials with the exception of vitamin A. 200, 600, and 1200 micrograms of carotene per 100 grams of ration were used for the different lots. Representative chicks were killed and the livers were analyzed for vitamin A at 4, 8, 12, 16, and 20 weeks of age. The vitamin A content of the livers increased up until the chicks were twelve weeks of age after which age there was very little apparent increase in the vitamin A content of the livers. Livers of the chicks receiving 200, 600, and 1200 micrograms of carotene per 100 grams of ration respectively contained 11, 33, and 93 parts of spectro vitamin A per million parts of liver. This increase in the vitamin A content of the livers is almost in direct proportion to the micrograms of carotene per 100 grams of feed.

R. M. Sherwood, G. S. Fraps, J. R. Couch, L. E. James.

Comparative Feeding Value of Meat and Bone Scraps

In an experiment in cooperation with the Division of Chemistry and Feed Control the comparative feeding value of five different samples of meat and bone scraps was studied. These samples of meat and bone scraps were fed in rations containing 175 micrograms of pure carotene per 100 grams of ration. The data in this experiment indicated that there was

in some cases some factor or factors in meat scrap which have a destructive effect on the carotene or vitamin A in the ration. Further studies are being made studying the exact cause of this carotene or vitamin A destruction.

F. D. Fuller, R. M. Sherwood, G. S. Fraps, J. R. Couch.

Maximum Crude Fiber Content of Chick Starting Rations

A preliminary experiment was conducted in cooperation with the Division of Feed Control to determine the amount of crude fiber that can be tolerated by chicks in order to know whether the chemical standards (particularly the maximum amount of crude fiber that may be allowed) adopted by the Feed Control Service for chick starters are correct.

Amounts of crude fiber from 4½ per cent to 11 per cent were used in this study. Fiber from oat hulls and from pulverized cane chew were used in this study. The data from the preliminary experiment indicated that possibly 7 per cent of total crude fiber in rations for growing chicks is a maximum amount. Increasing amounts of fiber results in poorer gains and poorer efficiency of the feed. No feather picking was observed in this experiment and mortality was not a factor. The work is being continued with a relatively pure type of crude fiber in the place of the oat hulls and pulverized cane chew.

F. D. Fuller, R. M. Sherwood, L. E. James.

RURAL HOME RESEARCH

Effect of Degree of Fatness on Tenderness of Lamb

(In cooperation with School of Agriculture, A. & M. College of Texas)

Five pairs of twin lambs of the same sex and of approximately equal weight at the beginning of the test were fed individually. One of each pair was full-fed and the other limited fed. The left legs were cooked and tested for tenderness by the pair-eating method. Separable fat was obtained for each wholesale cut in the right side of the carcass. The data were insufficient to warrant conclusions. Additional pairs of lambs are now on feed.

Sylvia Cover, J. C. Miller, and C. E. Murphey.

The Chemical and Physical Factors Responsible for Tendering Meat During Cooking

Paired roasts are being cooked in identical ovens, one regulated at 80° C. and the other at 125° C. to check results obtained in ovens of different types.

Other paired roasts are being cooked well-done at the same cooking temperature, one in a water bath and the other in an electric oven. Comparisons are being made for tenderness and time of cooking.

Chemical tests for collagen are being made on these roats.

A manuscript entitled "some Modifications of the Paired-Eating Method in Meat Cookery Research" was published in **Food Research** 5:379-394, 1940.

A manuscript under the title "The Effect of Metal Skewers on Cooking Time and Tenderness of Beef" has been accepted for publication in **Food Research.**

Sylvia Cover.

Processing of Canned Meat

(In cooperation with the Division of Veterinary Science)

Heating curves inside sealed cans of ground meat have been obtained by means of thermocouples. Calculations based on these curves indicate that, with preheating procedures advised by the Texas Extension Service, a processing time shorter than that now used may be safe. These results are being checked further by inoculation of test cans with spoilage organisms.

Sylvia Cover, H. Schmidt, and R. D. Turk.

The Mineral Composition of Vegetables Grown in Representative Regions of Texas and the Relation of Variation in Mineral Content to the Probable Nutritive Value

(In cooperation with the Divisions of Horticulture and Chemistry and cooperative with other southern states, the U. S. Plant Breeding Laboratory in Charleston, S. C., Texas Technological College, Texas State College for Women, and University of Texas)

Using seed from a common source, the Experiment Station at Iowa Park, Winter Haven, and College Station planted in 1940 Seven Tops turnip greens; Texas Technological College planted Cream Crowder peas and spring and fall crops of turnip greens. The Experiment Station applied fertilizer according to the adopted factorial design; Texas Technological College according to home-garden practice around Lubbock. The turnip greens crop at Iowa Park was lost through damage by grasshoppers, the fall crop of greens at Lubbock by cold weather.

The Division of Rural Home Research has determined the moisture content in the fresh greens and dried for mineral analysis the samples from the 1940 crop grown by the Experiment Station. Texas Technological College has prepared for analysis the samples from the crops grown there.

Analysis by the Division of Chemistry of samples from the 1939 experimental plats shows those from Winter Haven to contain an average of 2.34% calcium and 0.66% phosphorus, those from Iowa Park 2.48% calcium and 0.40% phosphorus. Stage-of-growth samples from the 1939 crop at Winter Haven and College Station were analyzed for protein, fat, nitrogen-free extract, fiber, and total ash; data are too few to present. The Division of Chemistry has participated in referee work on determination of moisture in dried samples and on method for iron. Determination of iron by the adopted method is now in progress on the 1939 samples.

Texas Technological College has found in turnip greens grown there in 1939, 2.92% calcium, 0.45% phosphorus and 239 ppm iron, and in greens from the 1940 crop 3.27% calcium, 0.47% phosphorus, and 298 ppm iron. Thirty-nine samples of greens from the 1938 crop at College Station in a supplementary study of mode of harvesting have been analyzed for calcium, phosphorus, and iron by Texas Technological College. A report is in preparation.

Statistical analysis of the findings on calcium and phosphorus in the samples from the 1938 crop, done by the Division of Rural Home Research and checked by Dr. B. L. Wade of the U. S. Plant Breeding Laboratory in South Carolina, shows a significant difference between fertilized and unfertilized samples both at Winter Haven and College Station, but highly significant only for calcium at College Station. Greens from College Station contained a highly significant greater amount of calcium (3.04% fertilized, 3.32% unfertilized) than those from Winter Haven (2.62% fertilized, 2.75% unfertilized) and from Iowa Park (2.85% unfertilized); Winter Haven and Iowa Park did not differ significantly. Phosphorus content of greens from both College Station (0.67% fertilized, 0.60% unfertilized) and Winter Haven (0.64% fertilized, 0.59% unfertilized) exceeded that in greens from Iowa Park (0.35% unfertilized) to a highly significant degree; College Station and Winter Haven greens did not differ significantly. Analysis of variance of the 1939 samples gave an F value below significance for both calcium and phosphorus.

In conjunction with the supplementary study on the composition of greens harvested at successive stages of growth, the Division of Rural Home Research has conducted tests on the eating quality of greens from the 1940 crop at College Station. Samples of the greens at each harvest were cooked in several cooperating homes, and several samples by Home Economics classes at Texas Technological College, University of Texas, and North Texas State Teachers College. Nine samples taken at regular intervals between October 10 and December 11 showed a remarkably uniform quality, rated fair to excellent on tenderness, bitterness, and characteristic greens flavor. Variation in score appeared not related to age of greens. Cooking time varied from 13 minutes to 2 hours 5 minutes; differences seemed to be much more influenced by household custom than by age of the greens.

Mechanical shearing tests showed tenderness of leaves and stems to be practically the same in each of the stage-of-growth samples. Shearing strength increased progressively, very slightly over the first three weeks, afterward more rapidly. The average shear for the stems ranged from 12.8 to 22.0 pounds; for the leaves, from 11.2 to 19.6 pounds.

Jessie Whitacre, S. H. Yarnell, G. S. Fraps,
L. R. Hawthorn, B. S. Pickett.

Effect of Tea upon the Energy Metabolism of Children

Two series of experiments have been made with 15 children 10 to 13 years of age. A Benedict-Roth recording respiration apparatus was used to measure the oxygen consumption under basal conditions and immediately following basal determination at regular intervals after ingestion of 300 cc of the test beverage, either ice tea or lemonade. The two beverages contained equal amounts of lemon juice and sugar. The effect of caffein should therefore be shown by the difference in increase of oxygen consumption over basal caused by the two beverages. Each child was subject in 2 or 3 experiments with lemonade and in 3 to 6 with tea.

In the first series of experiments there were 8 children who varied in habit of consuming foods containing caffein and theobromine. They ate their usual diet. In the second series, each of the 7 children abstained from all foods containing caffein or theobromine for from one to two weeks prior to the first tests with tea. Subsequently, tests with both beverages were repeated following daily ingestion for at least a week, of tea of the same strength as used in the experiments, in addition to other caffein-, or theobromine-containing foods as desired.

The course of oxygen consumption following tea ingestion was strikingly similar to that following lemonade. As a rule the observed peak of oxygen consumption was in the test ending 30 minutes after the beverage was drunk, and oxygen consumption had returned to basal level in 2 hours. In no case was there any evidence of establishment of tolerance. No child had the maximum observed rise after tea consistently greater than after lemonade. In a statistical test, data obtained for each child were averaged for each beverage. For the entire group, the mean oxygen consumption at 30 minutes after drinking the beverage was identical for ade and tea, differences at the 1 hour and the 1½ hour determinations were in favor of the ade, small, and not statistically significant as shown by the "t" value. With data for each child treated separately and 66 comparisons made, there were found, distributed among four children, only 6 statistically significant differences, three at the 1% level, three at the 5%, with increase in oxygen consumption greater after ade in two instances and after tea in four.

The final report of this study is nearing completion.

Jessie Whitacre.

Study of Body Measurements for Sizing Children's Garments and Patterns

The second report on this project by the Bureau of Home Economics, a technical account of all procedures and comparison of data secured from the 14 participating states, was in manuscript form in June 1940.

The first analysis of the Texas data made by the Division of Rural Home Research using the socio-economic classification designed for the project, showed the Houston and San Antonio children of each age group to re-

semble each other in body dimensions as did those in the Lubbock and the Denton-Dallas groups. The Houston and San Antonio children were the larger in most measurements.

A second analysis now in progress is based on a reclassification of the children according to parents' occupation into six groups, professional, semi-professional, business, farmer, skilled labor, and common labor. This reveals that the occupational composition of the Houston and San Antonio groups is different from that of the Lubbock and Denton groups, the former two having relatively more in professional and semi-professional groups (Houston 20%, San Antonio 25% of their respective totals) than has Lubbock (11% of total number) and relatively fewer in the common labor and farmer groups, (Houston 12%, San Antonio 9% versus Lubbock 26% and Denton 20%).

The incomplete analyses indicate that differences in body dimensions are associated with occupational group. Illustration is made with the 9-year-old children in Houston and Lubbock. Among all possible comparisons between occupational groups, there were found 17 differences within the Houston group and 7 within the Lubbock that are of certain or probable statistical significance. The mean measurements for professional, semi-professional, and business were greater than those for skilled and common labor. Comparing the corresponding occupational groups in Houston and Lubbock, statistically significant differences were found only in the business group. Out of 72 differences only 7 were significant with only one of the critical ratios as great as 4.

Jessie Whitacre.

Physical Characteristics in Cotton and Their Interrelationship

Succeeding generations of hybrid lines resulting from a cross of Lightning Express and Half and Half varieties, cotton furnished by the Division of Agronomy, were studied.

It was found that the fibers of the Lightning Express parent were longer, finer and stronger than those of the Half and Half parent.

The average length of the F_1 fibers was midway between the average lengths of the two parents; that of the backcross of the Lightning Express and F_1, was the same as the Lightning Express; and that of the F_2 generation approached the length of the longer parent, Lightning Express.

The F_1 and the F_2 generations were approximately midway between the two parents in fineness. The backcross was slightly finer than the finer parent, Lightning Express.

The fibers of intermediate length had in general a higher percentage maturity than those of the longest and the shortest length. No inheritance of maturity was indicated.

In each of the five lots of cotton there was a high positive correlation between length and fineness. Both length and fineness were closely correlated with strength.

The F_1 and the backcross were approximately equal in strength. The strength of the F_2 was slightly less and that of the F_1 greater than the average of the two parents.

In no case was it possible to assign definite factorial or genetic basis for the inheritance of the several properties studied, although multiple factor independent inheritance was indicated.

The report of this study is being submitted for publication.

Mary Anna Grimes.

The Serviceability of Garments as Affected by Varietal and Regional Differences in Cotton Fibers and by Method of Harvesting

(In cooperation with the Textile Engineering Department of the Texas Technological College)

The extent to which the variety of cotton, the region where grown, and the method of harvesting affect the serviceability of garments is being studied.

Acala and Rowden, two varieties which differ in fiber properties and which show regional differences, are to be grown two or more years in each of three regions of Texas, the Blacklands at Temple, the High Plains at Lubbock and the Gulf region in San Patricio county. Two methods of harvesting, picking and snapping, will be used at Lubbock.

Each lot of cotton will be manufactured into yarn and broadcloth in the Textile Engineering Department of the Texas Technological College. The broadcloth will be made into men's white shirts and the shirts will be worn by members of the Experiment Station staff, each man wearing one shirt from each lot of cotton.

The study will include analyses of the fibers, yarns, fabrics, manufacturing wastes and garments. The relationship between laboratory and wearing tests and the reliability of laboratory tests as a means of predicting the serviceability of garments will be studied. The effect of laundering will be determined.

Unfavorable weather at planting time prevented the growing of cotton in the Gulf region this past year but it is hoped that this region can be included in 1941. The six lots of cotton from Temple and Lubbock have been harvested, ginned, and classed and sent to the Texas Technological College for manufacture into broadcloth.

The analyses of the physical properties of the six lots of cotton are under way.

Mary Anna Grimes and Roland L. Lee, Jr.

APICULTURE

The Apicultural Research Laboratory is located near San Antonio with a yard near Dilley and an outyard in cooperation at Roxton.

Activities of Bees

The activity of the honey bees is more nearly controlled by weather conditions than are the activities of other animals utilized by man. Their life activities extend over but a few degrees of temperature. At thirty-two degrees F. an individual bee dies. At one hundred-twenty degrees F. both individual and colonies of bees die. At fifty-seven degrees F. the laying of eggs, collection of nectar, and rearing of young commence. At ninety-four degrees F. all work in the field stops. Whether or not this temperature is the point at which bees experience a depression of vitality due to heat, or whether it is at this point that evaporation has reduced the nectar in the flowers to a crystalline substance and the pollen to dry powder so that neither can be carried is yet to be determined. From the beginning of bee work at this station these limitations were recognized and a tabulation was made of the days on which mean temperatures drop below fifty-seven degrees and those during which the maximum temperatures go above ninety-four degrees. This division of temperatures shows considerable duration of below activity temperatures for the first three months of the year, an almost blank space during parts of March, April, May; then an almost solid strip through the latter part of May, June, and July, this being the period of greatest activity. A narrow space occupying parts of July, August, and September indicates the division between spring activity and fall activity. A narrow solid strip in November and December indicates that the bee activity for the year is over. During the present year these tables have been compared and it was found that the more compact these lines and greater the space between them the larger the honey flow. In comparing the scattered data which have been collected from north to south on the early activities of bees the gaps between the periods became greater in width. The lines indicating periods of greatest activity increase until the gap between the periods of activity in the spring and activity of fall disappear. In the extreme southern part of Texas the line of most activity at each end of the year became very narrow and the working period in the center of the year divides into two sections giving definite periods to the beekeeping year which have been named for convenience: winter quiescence, spring activity, summer quiescence, fall activity, winter quiescence. In the lower Rio Grande Valley these divisions of the year are very well marked. As the season proceeds northward the summer quiescence becomes narrower and winter space becomes wider. The summer quiescence is quite well marked as far north as Red River. From the records of others by the time that one has reached the latitude of St. Louis, Mo. the summer quiescence has completely disappeared and the gap between the winter quiescence and summer activity is divided by only a few days which is also the case in the divisions between summer activity and fall wintering period. These observations have brought out very pronouncedly the relationship between outside temperature and

the rearing of queen bees giving considerable information as to management necessary in the rearing of queen cells throughout the entire summer period by manipulation.

H. B. Parks.

Adaptability of Native Plants

The demand for information relative to plants and especially those native to Texas is great. The information asked concerns almost every plant which grows or can be grown in the State of Texas. On definite request a number of plants have been added to those already on trial here.

Melilotus Alba Var. Annua. Annual Sweet Clover. The test of the annual white sweet clover was the first one started at this place with the hope of obtaining a honey plant of worth that could take care of itself on the unoccupied lands along roads and ravines. Private investigations in this section had found that sweet clover could not be grown from seed sown in the spring. Investigations indicate that the annual sweet clover if sown in November or December receives a small amount of rainfall, the clover will germinate, and make a sufficient growth to give a honey flow the next spring, and that it will reseed itself. During the first years of trial the clover often died from drought. Due to natural selection the clover grown in this vicinity is now able to maintain itself and to spread without man's aid. A perpetual blooming strain has been selected here with the hope that it may prolong the nectar secreting period of this plant from early spring until late fall.

Amoreuxia Wrightii A. Gray. The beauty of this plant and the publicity given it, have created a great demand. As yet no information is at hand as to the rearing of the plant from seed and the supply of tubers secured in the wild is not yet sufficient to supply the demand for those who wish to experiment. It is very definite that this plant will become a popular yard ornamental when the tubers can be offered for sale.

Amaryllidae. The experiments with the plants of this family commonly known as rain lilies continue and during the present year two new species were added to the collection. This year which was very adverse to all foulb plants demonstrates the value of native rain lilies as ornamentals. Last year only a few of them bloomed and up to the first of August 1940 no blooms were recorded. When rains commenced those thought dead two years before came into bloom. Some few of these native plants are worthy of propagation by flower growers. Others do not respond sufficiently to attract anyone save an experimenter.

H. B. Parks, A. H. Alex.

Queen Rearing

The strain of three-banded Italian bees which was brought into existence at this Laboratory continues to show that they are superior honey gatherers. They are very resistant to severities of weather, can protect their hives

from the ravages of the bee moth and in the short period of time in which they have been tested for resistance to American Foulbrood that they also are resistant to this bee disease. This strain is kept pure. During the past summer a sufficient number of these queens was raised to requeen the Laboratory yard and to head the overwintering colonies of the mating yards. This precaution was necessary as a safeguard against the ravages of the wax moth.

A. H. Alex, H. B. Parks.

Queen Rearing for Resistance to American Foulbrood

(In cooperation with Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture, and the Iowa and Wyoming Agricultural Experiment Stations)

The work in 1940 was conducted in five yards to secure the required number of matings needed. One thousand eighty-six queens were reared and distributed to cooperators and State Agencies who wished to try the strain. Reports received from Washington indicate that the queens reared during the year 1939 showed an increase of one-third resistance over commercial bees. No reports on the resistance of 1940 queens have as yet been released. Of the forty-seven queens distributed to queen breeders within the State of Texas, eleven reported favorably on the queens received, asked for further distribution, and permission to sell daughters of the queens received.

H. B. Parks, A. H. Alex.

Horsemint for Honey and Oil Production

Again the complications in the Orient have brought the question of horsemint oil into prominence. Data are still being taken upon this promising source of an addition to the honey flora and oil for medicinal purposes.

Much data and information are at hand and already available on the production of this plant and recovery of oil whenever a market is assured.

H. B. Parks, A. H. Alex.

Plant Survey of the State of Texas

During the present year large numbers of occurrence records have been obtained together with the records of new plants collected in Texas, and a considerable number new to science. It has become necessary due to demand for such information that the cultivated plants also be placed on record. To this end a complete list of all plants growing in Texas was undertaken and is now well under way. It is the purpose to record the names of all native plants, in addition those plants that are grown for any purpose whatsoever, and those plants which are definitely called weeds. As a result of this survey it is proposed to issue a standardized plant name list of all of the plants occurring within the State.

H. B. Parks, V. L. Cory, et al.

Plants for Tannin

Canaigre is still being investigated as a source of tannin. The work began at this Laboratory in 1922 and still continues as a cooperative project with the Bureau of Plant Industry. This long experience indicates that Canaigre can be grown in this part of Texas in sandy land that is not adapted to any farm crop, that the plant will survive with the least amount of cultivation, and will make a field crop during a majority of years. The year 1939 produced but few tubers, however the 1940 crop showed a yield equal to that of the sweet potato crop in this section. Canaigre like Horsemint would become a farm crop were there any demand for it.

H. B. Parks, A. H. Alex.

The Genus Rhus

At the suggestions of the Bureau of Plant Industry the various members of the genus Rhus, commonly called sumac, are being studied in relation to beekeeping. The use of this genus as a source of tannin is being investigated by the Bureau. The observations of the present year give the following results that are worthy of record.

Rhus Virens **Lindh.** The Evergreen Sumac. A beautiful ornamental, however it seems to be limited to heavy limestone soils. It can not be depended upon in the flat lands in the southwest as an ornamental because of its susceptibility to root-rot. The evergreen sumac blooms in September and October and is looked upon as being valuable to the beekeepers who move their bees to the Edwards Escarpment to take advantage of this honey flow.

Rhus Microphylla **Engelm.** This plant is an inhabitant of the Eocene soils of the Gulf Coast and sparingly elsewhere. It blooms abundantly in early spring giving the bees considerable spring stores. It is not an ornamental but is found to contain considerable tannin.

Rhus Quercifolia **(Michx.) Steud** is a low growing shrub found through the post oak covered sandy lands of Texas. It is not poisonous to some people but very much so to others and as a rule it is not recognized as a poisonous plant. It is worked by bees to a certain extent for pollen and was not found to contain any great amount of tannin.

Rhus Trilobata **Nutt.** and its varieties. All these supply the bees with considerable nectar and are utilized as browse plants. They are used in mass plantings by landscape gardeners.

H. B. Parks, A. H. Alex.

S. M. Tracy Herbarium

The collecting of herbarium specimens and preparation of those obtained through gift and exchange have occupied considerable time during 1940.

In connection with the herbarium work there has been collected through this Laboratory forty samples of plants ranging from a few specimens to fifteen to twenty pounds. This is material needed by investigational institutions and recognized herbariums. Some five hundred herbarium sheets of foreign plants and a larger number of native plants were secured in exchange for these bundles of plants needed for chemical and other analyses.

H. B. Parks.

AGRICULTURAL ENGINEERING

Mechanical Harvesting of Cotton

In 1940, September 11 and 12, 20 different strains, crosses, and varieties were tested at College Station for their mechanical harvesting qualities with the Texas Station Cotton Harvester. Because of heavy rains in early July, the cotton plants at College Station produced excessive foliage and averaged 33 inches in height. Some plants grew to a height of 4 feet. While the ground was wet, winds caused the plants to fall down in all directions in relation to the row. As the plants did not straighten, it was impossible for the pick-up fingers on the harvester to pick up all the plants along the row; consequently, the average efficiency of the harvester was only 84.7 per cent as compared with 94.6 per cent in 1939. In harvesting 13 special strains that had not fallen down so badly, an average efficiency of 90.6 per cent was obtained. The 19 strains, crosses, and varieties tested at Lubbock averaged 13 inches in height, and the machine harvested an average of 96.8 per cent of the cotton on the plants. At College Station picked cotton averaged middling plus and snapped and machine-stripped cotton middling. At Lubbock the picked cotton averaged slightly better than middling and the machine-stripped cotton low middling plus.

The breeding work was continued at both College Station and Lubbock. A description of the work is reported by the Division of Agronomy.

Snapping Qualities of Cotton Bolls: The average number of pounds required to pull open cotton bolls from the plants was obtained for all varieties tested for mechanical harvesting at both College Station and Lubbock. In addition, the bolls were pulled from more than 200 specially selected plants. Data were also collected on the length and diameter of the peduncle and the degrees the boll carpels were spread apart. All these factors were identified with the pull of each boll so that correlation studies could be made. For the varieties tested at College Station, the pull ranged from 2.9 pounds for Deltapine, 12 to 10 pounds for Bennett's Quick. The general average for all varieties was 5 pounds. At Lubbock the pull ranged from one-half pound for Hibred to 4.2 pounds for Mebane 140. The average for all varieties was 2 pounds.

Spread of Open Cotton Bolls: Cotton bolls that were measured at College Station on September 6 had a spread ranging from 103 to 125 degrees.

The average for all varieties tested was 114 degrees. At Lubbock on November 14 the range was from 103 to 128 degrees, with an average of 114 degrees.

Green Leaf Studies: In November after the field tests with the Texas Station Harvester were completed, a spiral auger conveyor was fitted in a trough made of specially designed perforated sheet iron in an effort to find a device that would eliminate a large percentage of the green leaves from machine-stripped cotton. The device was tested at different speeds and different angles with the horizontal. Leaves removed in traveling the length of the conveyor ranged from 20 to 25 per cent. Best results were obtained when the conveyor was operated at approximately 107 R. P. M. and set at an angle of 30 degrees.

Plant Characteristics: Approximately 200 plants were selected on the basis of plant type suitable for mechanical harvesting, and the various characteristics were studied to determine their reaction to mechanical treatment. Notes were made on the stalk type; foliage density and shedding qualities; fruiting habit; number, size, and shape of bolls; boll pull and spread; and fiber characteristics, such as fineness, density on seed, length of staple, interseed drag, adherence to seed, and percentage of lint. The cotton from each plant was cleaned with a small cleaner to determine cleaning and roping characteristics.

H. P. Smith, D. T. Killough, D. L. Jones, M. H. Byrom.

Efficiency in Distribution and Placement of Cottonseed and Fertilizer

Machine Placement of Fertilizer and Soil Disturbance Studies: For five years experiments have been conducted at both College Station and Nacogdoches to study the comparative effects of fertilizer placement and soil disturbance. In this experiment a check is planted for each placement of fertilizer. In 1940, where the fertilizer was placed under the seed, different results were obtained at College Station and Nacogdoches. For each test at College Station more seedlings emerged on the fertilizer rows than on the checks, while at Nacogdoches fewer seedlings emerged on the tests where the fertilizer was placed 1 and 2 inches under the seed but more emerged where the fertilizer was placed 3 inches under the seed than for the check. The placement 3 inches under the seed gave the highest yield at both locations. In all the tests where the fertilizer was placed to the side and below the seed level more seedlings emerged on the fertilized tests than on the unfertilized checks at both locations. The highest yield at College Station was obtained where the fertilizer was placed 2 inches to each side and 1 inch below the seed level. The highest yield at Nacogdoches was where the fertilizer was placed 2 inches to each side and 2 inches below the seed level.

Width of Furrow Openers: Better stands and yields were obtained with a narrow furrow opener than with a wide furrow opener.

Effect of Press Wheels: Press wheels used before and after covering cottonseed gave the best stands with both the knife and wide shovel furrow openers. The best stand obtained with the narrow furrow opener was without a press wheel.

Hill Dropping of Cotton: Five tests were planted with a hill-drop planter. One of these was left unthinned, while the others were thinned so that they had 1, 2, 3, and 4 plants per hill. The stand on the unthinned test compared closely with the test where there were three plants per hill. The highest yield of 320 pounds of lint per acre was obtained where there were two plants per hill. The next highest yield was 310 pounds per acre where there were four plants per hill. The unthinned test produced 268 pounds of lint per acre.

Treatment of Cottonseed for Planting Purposes

Results obtained for the fifth year of the experiment to determine the effects on germination of treating non-delinted and acid-delinted cottonseed with Ceresan, lime, and sulphur at College Station and Nacogdoches are as follows:

For the four treatments, Ceresan-treated non-delinted cottonseed gave better stands at both locations. The yields, however, were highest for the untreated seed. Ceresan-treated acid-delinted seed gave best stands and yields at Nacogdoches, while the sulphur-treated delinted seeds gave the best stands and the lime-treated delinted seed gave the best yields at College Station. When the results of the two locations were averaged, the Ceresan treatment gave the best stands and yields for the delinted seed.

H. P. Smith and M. H. Byrom.

Atmospheric Exposure of Wire and Fencing

(In cooperation with the American Society for Testing Materials)

Six bare non-copper-bearing and six bare copper-bearing samples were returned for tensile strength tests and chemical analyses. The zinc-coated samples show more weathering but no real corrosion. The corrosion resistant steels show some rust. Details of the condition of all samples appear in the "Wire Test Report" published by the American Society for Testing Materials, Philadelphia, Pennsylvania.

H. P. Smith and M. H. Byrom.

Garlic Drying

The experiments in drying garlic to control decay were continued on the same plan in 1940 as in 1939. Three replications of 12 treatments of

garlic were planted on the Joe Story farm near Moulton on November 17, 1939, and harvested from May 26 to 29. The garlic from one of the replications was dried in the drier for 24 hours at an average temperature of 116° F. That from the second replication was dried on wire shelves under a sheet iron roof for 15 days. The garlic from the third replication was left in the field for 10 days exposed to the weather.

The average loss from drying in the drier was 19.9 per cent. The average cleaning loss for the dried garlic was 8.0 per cent. Loss while in storage for No. 1 garlic from June 14 to September 18 averaged 16.2 per cent. Loss from decay in storage was 1.4 per cent. No. 2 garlic lost 13.0 per cent from shrinkage and 1.1 per cent from decay. The garlic dried in the shade for 15 days lost an average of 25.0 per cent from drying and 5.8 per cent in cleaning. The average shrinkage loss for No. 1 garlic in storage was 5.8 per cent and from decay, .07 per cent. No. 2 garlic lost 8.5 and .59 per cent, respectively, from shrinkage and decay.

The garlic left in the field was not weighed until it was topped; therefore, the shrinkage loss from drying was not obtained. The average loss from cleaning was 9.6 per cent. The average loss for No. 1 garlic while in storage from June 14 to September 19 was 16.8 per cent. Decay loss in storage averaged 3.8 per cent. No. 2 garlic lost in storage 13.1 per cent from shrinkage and 2.2 per cent from decay.

When graded, the garlic averaged 41.5 per cent U. S. No. 1, 45.1 per cent U. S. No. 2, and 13.4 per cent culls.

The effect of the various chemical treatments is reported by the Division of Plant Pathology and Physiology.

H. P. Smith, M. H. Byrom, and G. E. Altstatt.

WILDLIFE RESEARCH

(In cooperation with the Agricultural and Mechanical College of Texas, the Texas Game, Fish and Oyster Commission, the American Wildlife Institute, and the United States Department of Interior)

County Wildlife Resources Surveys

As pointed out in last year's annual report, recommendations for many phases of wildlife management are being worked out with selected counties in the 11 ecological types insofar as possible in the 39 types of farming areas in Texas. Field work in Walker, Colorado, Kerr, and Harris counties has been completed; it is in progress in Brazos, La Salle, and Culberson counties.

A. Walker County (East Texas Timber Type)

The manuscript of the entire Walker County report was well advanced during the year, and on June 30, 1940, the final touches were being put upon it by D. W. Lay, S. R. Warner, and W. P. Taylor.

B. Colorado County (Eastern Texas Timber Plus Coastal Prairie Type)

Five persons have been occupied with this project off and on over a period of two years. The field record is more than 95 per cent completed, and the results are being prepared for publication by Lehmann. Attention is called to the following points: (1) a vegetative map was made of the entire county, 622,000 acres, and 15 major types established. Of these oak woods and tall grass prairies were found to be the most extensive, and have the greatest potentialities for game management; (2) the relation of blackbirds to rice, corn and other crops was investigated, and the effects of guns, poisons, scarecrows, and other control methods tested; (3) the life history of the white-tailed deer in southern Texas was closely studied; (4) the economics of game was investigated; (5) the value was demonstrated of brush shelters, pole shelters, food patches to quail in the Coastal Prairie of Texas. (Where headquarters areas were installed in approximately 100 instances there was 75 per cent occupancy during the year. Quail were censused on 42,000 acres with bird dogs; quail populations in Colorado County in March 1939 was estimated to aggregate 16,828 birds); (6) over 3,000 bird nests of 31 species were studied. Rains, snakes, and grackles were found most important enemy of tree-nesters, and rain and snakes the most important enemy of ground-nesters.

C. Harris County (Coastal Prairie Type)

Three investigators worked during the summer of 1938 and subsequently on this county. Field records are completed and the results are being got together chiefly by T. F. Smith. Only about 150 individual Attwater prairie chickens remain in Harris County, if that many. The gradual tendency is for rice farming and other forms of agriculture, together with a number of other factors, to crowd out the Attwater prairie chicken. Ring-necked pheasants do not do well in Harris County.

D. La Salle County (Brush Country)

Two men worked during a summer season in 1939 and at intervals through the winter. A map of vegetative types was completed, five main types being outlined. Wide range in annual precipitation, once varying from 1.9 inches to 43.9 inches during a 3 year interval, is probably the greatest factor limiting game in La Salle County.

Removal of habitat and commercialization by professional hide hunters were the principal reasons for reduction of peccaries in La Salle County. The new law closing the season except between November 15 and December 31 should promote their increase.

The principal game species is the white-tailed deer. The number of acres in shooting preserves increased from 98,900 in 1936 to 328,212 in 1939.

Ranchmen are beginning to recognize deer as a tangible asset to a greater extent than ever before, and the most progressive ones are taking steps to increase the deer on their land.

Observations made on an area heavily stocked by cattle but closed to hunting indicated that protection from over-shooting is one of the major factors in deer increase.

In addition to over-shooting, out-of-county ownership and over-use of the land by livestock are the main factors that have caused decrease in the number of deer in La Salle County.

The Agricultural Adjustment Administration program of livestock-water tank construction is having a beneficial effect on waterfowl, and encouraging their wide distribution over this ordinarily dry country.

E. Culberson County (Trans-Pecos Basin and Mountain)

This is a Department of Fish and Game project, led by Dr. W. B. Davis, assistant leader of the Texas Unit. The only work done up to date is that done during the summer of 1939. It is hoped to resume activities during the present summer.

It was observed during 1939 that due to the lack of surface water on top of the Guadalupe Mountains, black-tailed deer there were feeding on mescal, a fleshy-leafed *agave*, as a source of water. In addition, deer were observed feeding on a number of plants and several species of scrub oak. Competition for food between elk and deer was observed, this may be anticipated to increase in degree and seriousness.

A manuscript on the plants and mammals of the Guadalupe Mountains has been prepared by Davis; and George H. Lowrey and Thomas D. Burleigh, the former of Louisiana State University, the latter of the Fish and Wildlife Service, have prepared a paper on the birds of this area, using for the purpose, in part, the specimens collected by members of the Texas Unit and the Department of Fish and Game of the A. and M. College.

Quail Management in Texas

A Study of the Effects of Introducing Texas Bobwhites

(a) A Genetic Experiment at College Station

Following are the results of the sex-determination examinations of 321 embryo quail up to June 30, 1940:

	Males	*Females*
Mexican[1] x Virginia[2]	74	75
Texas[3] x Texas	8	8
Virginia x Virginia-Texas^{F2}	20	16
Virginia x Virginia	36	23
Mexican x Texas	7	6

Virginia x Texas	26	16
Virginia x Mexican-Virginia^{F1}	1	5
TOTAL	172	149

[1]Mexican—*Colinus virginianus texanus*
[2]Virginia—*Colinus virginianus virginianus*
[3]Texas—local hybrid between *Colinus virginianus virginianus* and *Colinus virginianus texanus*

D. H. Reid, Head
Department of Poultry Husbandry
School of Agriculture
Agricultural and Mechanical College of Texas

Cover Control to Influence Food and Shelter for Quail

Hahn was able to complete a good deal of compilation work on this project, and also some experimental work on the College Farm, prior to his departure to take a job as assistant regional game manager with the Texas Game, Fish and Oyster Commission, in October, 1939. Experiments on the College Farm seem to indicate that the problem of cover restoration in the post oak region is one of giving voluntary cover plants a chance to re-establish themselves rather than to establish them by planting. Eight plots in Pasture 9 on the College Farm planted to a number of field crops did not give any results because of the drouth which prevented the plants from developing adequately. Hahn intends to prepare a paper on game management in post oak type, which includes the College Farm area, for submission in partial requirement for the Master's degree here at the College. This work will incorporate his results on cover control to increase bobwhite quail. Hahn has noted already that winter, while it may be mild in Texas, is often critical for quail. Both food and cover may be lacking, although in this part of the State food is more likely to be lacking than cover.

Headquarters areas located close to sheltering vegetation are recommended for the post oak type, especially where pasture mowing and clean farming have reduced the quail feed and cover. Quail census results on the A. and M. College Farm are given in the following table:

Quail Census Results
Texas A. and M. College Farm
Post Oak Woodland (pastures and cultivated land)

Season	Acreage	Population		Quail Density Acres per Quail
		Coveys	Quail	
Fall 1936	1,800	12	142	12.67
Fall 1937	1,800	17	184	9.78
Fall 1938	1,800	12	156	12.17
Spring 1939	1,800	10	115	15.65
Fall 1939	1,800	8	81	22.2
Spring 1940	1,800	12	72	25.0

Quail Management in the Coastal Plains and Prairie Regions of Texas

Under certain conditions in the Coastal Region, fenced headquarters areas to provide food and cover for quail have been found effective in holding quail on the Coastal Prairie throughout the winter. In October 1939, 100 such plots showed 63 in use, 37 vacant.

Ecological-Wildlife Relationships

Progress Report No. 382, "Some Quail Food Plants of Southeastern Texas," by Dr. S. R. Warner, was revised, and issued during the year as a progress report of the Texas Agricultural Experiment Station. Lists were provided giving seeding and fruiting periods, food value for bobwhites, and occurrence of 44 legumes, 11 spurges, 67 grasses and sedges, 9 members of the carrot family, 7 composites, 5 ragweeds, 39 other weeds, 8 species of mast-bearing trees, and 8 bushes or trees having fleshy fruits. There has been a consistent demand for this bulletin since its initial appearance in 1936.

Wildlife Resources of Second-Growth Pine Woodland

Lay's paper, "Bobwhite Population as Affected by Woodland Management in Eastern Texas," has been completed, submitted to the Texas Agricultural Experiment Station, and will be published during the present fiscal year. This paper was summarized in a former annual report.

Plant Development and Availability on the Campus of the A. and M. College

Chenault's paper, "Phenology of Some Bobwhite Quail Food Plants in Brazos County, Texas," has been finished, submitted to the Journal of Wildlife Management for publication, and will soon appear in that periodical. The paper has been noted in a previous annual report.

Life History and Ecology of the Gray and Fox Squirrels in Eastern Texas

Goodrum's work under this project has been previously summarized. His paper, "A Population Study of the Gray Squirrel in Eastern Texas," has been submitted to the Texas Agricultural Experiment Station where it has been accepted for publication, and will appear this fiscal year.

Life History of the Attwater Prairie Chicken

Lehmann's results on this project have been previously summarized. His paper will appear in one of the series published by the Biological Survey where it has been in line for publication since May, 1939. Research by Lehmann under Game, Fish and Oyster Commission auspices subsequent to the submission of the manuscript in question has shown that the Attwater prairie chicken tends to be further reduced in numbers

as time goes on. Rice culture is expanding in Colorado County, and it is only a question of time before most of the birds will disappear from that area. Apparently the only hope for preserving any considerable number of the birds is in Refugio and neighboring counties, where very large ranches may remain for a considerable period of years.

The Attwater prairie chicken once ranged over approximately 6 million acres of Gulf Coastal Prairie, extending from South Texas near Port Isabel to Louisiana in the vicinity of Opelousas, Abbeville, and Bayou Teche. The bird is now believed to be entirely extinct in Louisiana. According to the best information available, the former number of prairie chickens exceeded a million in favorable years. Rapid decrease occurred during the last 75 years. However, an intensive survey in Texas in 1937 revealed approximately 450,000 acres of range and a total estimated population of 8,711 birds.

A late report from Lehmann reveals that ". . . Causes of the decrease of the Attwater prairie chicken are many. Over 2 million acres of what was once the best habitat is now in cultivation. Pasture burning in spring destroys eggs and young; May rains are especially serious. Legal hunting has been very detrimental in the past because open seasons came in September, or earlier, when young of the year were physically and mentally immature. Heavy grazing has reduced cover and food; habitat has also been depleted by oil development, drainage canals, and roads.

"The Attwater prairie chicken may yet be saved. Better land management involving moderate grazing, erosion control, and carefully regulated pasture burning will help. Hunting in the future should be based on annual increase; open seasons should not occur before November 1. Landowners should cooperate more closely with conservation officers to reduce poaching. The existence of the Attwater prairie chicken will continue precarious, however, as long as all of their range is privately owned and privately managed. Large strategically located government-owned refuges would almost certainly insure survival. Action to acquire refuges must be prompt, however, for less than a dozen choice areas remain in the entire State."

The Mammals of Texas

Projected in 1938 to include accounts of all the recent and known fossil mammals, Davis, during the year, has prepared sections of a manuscript on "The Mammals of Texas," especially the marsupials, insectivores, and rodents. A check list of the recent mammals of the State has been prepared in manuscript form.

Attention has been given to the distribution, relationship, and ecology of the pocket gophers of the Genus *Geomys*, on the basis of a study of more than 600 specimens from Arkansas, Louisiana, New Mexico, Oklahoma, and Texas, several hitherto unrecognized geographic races have been found. Considerable new light also has been thrown on the ecological interrelationships of the pocket gopher and their environment.

Critical systematic studies of the relationships of the Texas Beaver and the Gulf Coast Muskrat have been made, and manuscripts prepared for publication.

Forest and Wildlife Relations

Under proper land management it begins to appear more clearly than ever that natural crops such as timber, deer, fur, livestock, and game birds, on some soils of eastern Texas will produce an income comparable to that of some of the field crops. "Back to Nature" in parts of this great region undoubtedly will be economically possible, and may even support larger populations than are now on the area. This policy also will result in better conservation of wildlife, forest, water, and soil.

Unfortunately W. H. Kellogg, who was following this project during the early part of this fiscal year, has transferred his employment first to the Soil Conservation Service, and later to the Game, Fish and Oyster Commission, so that temporarily his research work has had to be abandoned. It is hoped, however, that the job can be completed later.

Beaver Restoration in Texas

The leader of the project, Arthur H. Cook, received the offer of a job from the New York Conservation Commission and left the Texas Unit in January 1940.

While the beaver project has been temporarily abandoned as a result of Cook's leaving, the Game, Fish and Oyster Commission plans to include it in one of its projected Pittman-Robertson projects.

Fishes of Texas

Field studies between July 1, 1939, and June 30, 1940, were concentrated on Kerr and Brazos counties, with some study of adjoining areas and other localities. In Kerr County during July and August 1939 intensive seining with large nets gave a good picture of the relative numbers and kinds of fishes. Stomach analyses of 300 gars, contrary to popular belief, revealed no bass. 2,000 bass were banded (Guadalupe River).

During the present summer about 20 ponds have been surveyed biologically in the vicinity of College Station, as a basis for building up farm pond fisheries resources. Most of these ponds appear suitable for intensive fish culture using fertilizer.

The fresh water fisheries collections made under this project total to date over 200, and include 80 species belonging to 18 Orders. Besides these, there are about 40 marine species in the A. and M. Collection.

Most of the seining for the fisheries collection was done with the help of the fisheries classes, Department of Fish and Game.

Work on the systematics of the freshwater fishes of Texas is being conducted, in cooperation with the Texas Game, Fish and Oyster Com-

mission, the North Texas State Teachers College, the Rice Institute, and the University of Michigan.

The White-Necked Raven

A. S. Jackson of Throckmorton, Texas, working in close cooperation with the Unit, carried on a study of the ecology of the white-necked raven in that vicinity. Food of the raven, as indicated in regurgitated pellets examined at a water hole July 26, 1939, included grasshoppers and *Condalia* seeds as the principal items. Other items were the ribs and skull plate of a horned toad, periwinkle shell, camel crickets, grasshopper eggs, crushed femur head of rabbit, gravel, and small bones of a lizard.

The McCullough Experimental Farm Game Project

In March, 1940, negotiations were begun with W. R. McCullough, prominent Bryan ranchman and farmer, the Texas Game, Fish and Oyster Commission, and the Unit, looking to the use by the Unit of a tract of 2,514 acres of land, 10 miles east of College Station, as an experimental farm and ranch. Papers were executed by representatives of the Unit and by Mr. McCullough, giving the Unit exclusive wildlife rights on the area for a period of 3 years. The Game, Fish and Oyster Commission, and Unit, later signed papers assuring cooperation on a 15 plot quail increase project on the McCollough Ranch near the Pittman-Robertson tract. Already planted in 12 of the 15 plots under different conditions are sesbania, browntop millet, Florida beggarweed, common and sericea lespedeza, benne, dwarf milo, and redtop cane. Students from A. and M. College, under Davis' supervision, have surveyed 1,658 acres of the area, and already have made beginning studies of the vegetation, insect life, soils, and biota of the region.

Quail Food Plot Studies

A total of 26 plots of quail food plantings, made in the vicinity of College Station by the Texas Game, Fish and Oyster Commission and the Unit, are being kept under surveillance to determine the suitability for game of the various grains, legumes, and weeds.

Factors considered and evaluated include types of plants used, soil and climatic influences, planting techniques, erosion, and the value of the various species for tiding quail over the critical period of food shortage in this region.

FEED CONTROL SERVICE

Inspection

The usual inspection of feeding stuffs has been continued during the past year and eight inspectors have visited feed manufacturers, feed dealers, and a considerable number of consumers in order to secure official samples

or analysis and to detect possible violations of the Texas Feed Law. Each nspector is required to file at the office each week an itinerary which is ubject to revision if considered advisable. In addition he is required to ubmit a daily report of his activities. During the period covered by this eport the inspectors have traveled 112,992 miles in the performance of heir official duties and visited 20,304 firms in 4,555 towns and cities. Sev- ral trips were made from the office for the purpose of carrying on special nvestigations.

Computed from the sale of feed inspection tags, there were 1,705,552 ons of feed sold in the State during the fiscal year ended August 31, 1940. This amount represents only the tonnage of feeding stuffs regulated by he Texas Feed Law, and is based on the assumption that all the tags old during this period were used for feeds sold during that period. The 939-40 sale of feeding stuffs in Texas is the largest on record and has teadily increased during each of the past eight years with one exception. Cooperation with the Food and Drug Administration of the Federal Secu- ity Agency has been continued and thus control exercised over interstate hipments of feed as further protection to Texas feed purchasers.

Samples

During the fiscal year the inspectors secured 3,496 official samples of eed, which were subjected to chemical analysis and microscopic examina- ion by the Division of Chemistry. In addition to these, there were analyzed a few registration and special samples, making a total of 3,592 samples nalyzed during this period. In addition, twenty-eight samples of fish liver ils and fortified fish liver oils were assayed for vitamin D potency, and wenty-seven samples of cottonseed cake were tested for hardness. Three undred and eighty-five determinations of salt and three hundred and sixty- hree determinations of carbonate of lime in mixed feeds were also made. Thirty samples of feed were also tested for carotene content.

Reports

The results of inspections and analyses are reported to the manufacturer, ealer, and consumer as soon as practicable after the results are available. When a shipment appears to be adulterated or misbranded, the dealer is otified and advised to remove it from sale until the matter has been satis- actorily adjusted.

Shipments Withdrawn From Sale

During the year covered by this report dealers were advised to remove rom sale 646 shipments of feed, manufactured by 395 different firms, otaling 2,072 tons. These shipments were withdrawn from sale because hey did not meet the requirements of the law. Untagged shipments were roperly labeled with tags furnished by the manufacturers; improperly abeled shipments were relabeled with official tags properly printed, or

with tags showing guaranties that could be maintained, and in still other cases shipments were returned to the manufacturer. The sales of goods below guaranties were adjusted, in practically all instances, by manufacturers paying refunds to dealers and consumers when the deficiencies were sufficient to warrant such action. In all cases where refunds were made to dealers, the dealers were advised to prorate the same to their customers, in so far as possible, so that the ultimate consumer would receive its benefit.

Violations

During the year covered by this report five firms were cited for hearings to be held in the office of this Division for the purpose of presenting evidence to show cause why they should not be prosecuted for violating the law. Four of these firms sent representatives to the hearings and one replied by letter. Upon presentation of the evidence such action was taken as seemed advisable, although no firms were prosecuted under the provisions of the Texas Feed Law.

Six hundred and forty-three minor complaints were adjusted through correspondence, together with the assistance of the inspectors. These complaints consisted of untagged shipments of feed; improperly labeled shipments; incorrectly printed tags attached to packages of feed; short weights; deficiency in crude protein; excess of crude fiber, and other minor irregularities.

During the year there were six Federal cases developed against manufacturers shipping feed into this State in violation of the Food and Drugs Act of 1906. The necessary evidence in each case was transmitted to Federal authorities for legal action. These cases were then referred to United States attorneys having jurisdiction and prosecution of violators recommended. One of the cases was terminated by payment of fine and costs. Five cases are now pending.

Information has been received from Washington, however, that ten cases developed previous to September 1, 1939, were terminated on payment of fines and costs. The fines imposed amounted to $425.00.

Hardness of Cottonseed Cake

The determination of the hardness of cottonseed cake has been continued during the past year. Twenty-seven samples representing the output of twenty-seven oil mills were tested for hardness and the crushing strength varied from twenty-eight pounds, soft, to 1,695 pounds, hard. Most of the samples examined, however, were classified as medium hard.

Cooperative Research Projects

Allotments of funds of the Division for research projects to assist in the proper and adequate administration of the Texas Feed Law have been made to the following:

Division of Chemistry
Chemical Analyses and Investigations of Commercial Feeds
Vitamins in Commercial Feeds
Division of Poultry Husbandry
Protein Requirements for Chick Rations
Maximum Crude Fiber Content of Chick Starters
Division of Veterinary Science
Testing Manufactured Feed Samples for Poisons or Other Harmful Substances.

F. D. Fuller and James Sullivan.

PUBLICATIONS

During the fiscal year September 1, 1939, to August 31, 1940, the Division of Publications received for distribution 16 bulletins, Nos. 577-592 and 6 circulars, Nos. 85-90, and the Director's Fifty-first Annual Report. The Fifty-second Annual Report was received from the printer after the close of the fiscal year. Members of the station staff reported citations of publication of 53 papers in various scientific journals during the fiscal year. There were 53 progress reports prepared and mimeographed for dispatch to the press and various agricultural workers including the extension wokers and the Smith Hughes teaching staff. Additional supplies were prepared for filling requests. The stencils of all progress reports are at all times available and copies can be had in reasonable numbers. Abstract Circular 88 was prepared in this Division and carries abstracts of bulletins 567-580 inclusive and circulars 83-85 inclusive as well as the Director's Fifty-first Annual Report and the report of the soil survey of Hunt county. The circular carries abstracts of 36 articles by members of the staff that appeared in scientific journals. Approximately 50 of the progress reports were read over the Texas Quality Network under our arrangement wherein we have a five minute period each Friday from 6:15 a. m. Of the bulletins, circulars and reports published during the year 267,153 copies were printed up to August 31, 1940. Distribution was made of 182,542 copies leaving 915,128 on hand and available for free distribution on September 1.

The technical papers appearing in the various scientific journals on or before August 31, 1940, and not previously reported are cited and a tabulated report is made of printed publications received.

A. D. Jackson, Chief.

Technical Papers

437. The Effects of Partial Sterility on Fruit and Cane Development of Blackberry and Dewberry Varieties; H. F. Morris. American Society for Horticultural Science, Vol. 38, pp. 492-494, 1938.

446. A Dwarf Oat Found in a Nortex-Victoria Cross; I. M. Atkins and P. B. Dunkle. Journal of the American Society of Agronomy, Vol. 30, No. 4, pp. 347-348, April.

476. The Effect of Certain Mineral Salts on the Amount and Severity of Perosis; Ross M. Sherwood. Poultry Science, Vol. 18, No. 2, p. 165, March, 1939.

479. Controlling Tomato Wilt with Resistant Varieties; P. A. Young. Phytopathology, Vol. 28, No. 1, p. 22, January, 1938.

485. Vitamin A Requirements of Poultry; Ross M. Sherwood. Proceedings of the 7th Worlds Poultry Congress, p. 123, August, 1939.

492. Chemical Soil Treatment to Control Fusarium Lycopersici, Heterodera Marioni, and Weeds; P. A. Young. Phytopathology, Vol. 29, No. 25, 1939.

494. Carotene Requirements for Fattening Beef Cattle; J. M. Jones, J. K. Riggs, G. S. Fraps, J. H. Jones, H. Schmidt, R. E. Dickson, Paul E. Howe, and W. H. Black. Proceedings of the American Society of Animal Production, 1938.

496. Nursery Tests with Grape Rootstocks; E. Mortensen. Proceedings of the American Society of Horticultural Science, Vol. 36, pp. 153-157, 1938.

504. Progress Report on Boll Weevil Control Tests with Calcium Arsenates Containing Different Percentages of Water-Soluble as 205 Using Randomized Block Plot Arrangements at Gainesville, Florida; Tallulah, Louisiana; Port Lavaca, Texas; State College, Mississippi, and College Station, Texas; R. C. Gaines. Journal of Economic Entomologist, Vol. 32, No. 6, pp. 794-797, December, 1939.

507. Tomato Wilt Resistance and its Decrease by Heterodera Marioni; P. A. Young. Phytopathology, Vol. XXIX, No. 10, pp. 871-879, October, 1939.

508. Girdling of Cotton Plants as Affecting Survival of Phymatotrichum Omnivorum; Walter N. Ezekiel. Phytopathology, Vol. 29, No. 8, p. 753, August, 1939.

509. Relation of Variations in Rainfall in 1938 to Prevalence of Cotton Root Rot; Walter N. Ezekiel. Phytopathology, Vol. 29, No. 8, p. 752, August, 1939.

510. The Number of Farm Laborer Households in Texas; C. Horace Hamilton. Texas Conference of Social Welfare, January, 1939.

513. Changes in Vitamin C Content During the Boiling of Turnip Greens in Various Waters in Covered and Uncovered Containers; W. W. Floyd and G. S. Fraps. Food Research, Vol. 5, No. 1, pp. 33-41, 1940.

517. Factors Affecting the Absorptive Power of Magnesia for Carotene; G. S. Fraps, A. R. Kemmerer, and S. M. Greenberg. Industrial and Engineering Chemistry, Vol. 1, No. 1, pp. 16-18, January, 1940.

519. White Rust of Spinach; James S. Wiant, S. S. Ivanoff, and John A. Stevenson. Phytopathology, Vol. 29, No. 7, pp. 616-623, 1939.

521. Length of Treatment with Sulphuric Acid as Affecting the Survival of Fungi and Bacteria on Cotton Seeds from Diseased Bolls; Douglas C. Bain. Phytopathology, Vol. 29, No. 10, pp. 879-884, October, 1939.

522. A Technique for Making Photomicrographic Prints in Color; Hilton A. Smith. Journal of Technical Methods and Bulletin of the International Association of Medical Museums, Vol. XIX, pp. 45-51, 1939.

523. What Cooperation has to Contribute in Solving the Problem of Distribution; W. E. Paulson. Agricultural Economics Section of the Southwestern Social Science Association, Dallas, April, 1939.

529. Relation of Gain in Weight to Gain in Energy Content of Growing Chickens; G. S. Fraps, and E. C. Carlyle. Journal of Agricultural Research, Vol. 59, No. 10, pp. 777-782, November, 1939.

530. Physical Characteristics in Cotton and Their Interrelationship; Mary Anna Grimes. Journal of Home Economics, Vol. 31, No. 8, p. 560, October, 1939.

531. Some Effects of Contour Listing on Native Grass Pastures; B. C. Langley and C. E. Fisher. Journal of the American Society of Agronomy, Vol. 31, No. 11, pp. 972-981, November, 1939.

533. The Effects of Magnesium and Calcium on "White Tip" of Rice; Alan L. Martin. American Journal of Botany, Vol. 26, No. 10, pp. 846-852, December, 1939.

535. Notes on Texas Plants; V. L. Cory. Rhodora, Vol. 41, No. 41, pp. 561-564, December, 1939.

536. Six Thistles Recently Introduced Into Texas; V. L. Cory. Madrono, Vol. 5, No. 6, pp. 200-202, April, 1940.

537. Rice Straw Stacks as a Source of Infection with the Black Kernel Disease; Alan L. Martin. Plant Disease Reporter, Vol. 23, No. 14, p. 247, July, 1939.

539. Cytological Confirmation of Taxonomy in Cooperia; Walter S. Flory. Herbertia, Vol. 6, pp. 1-8, 1939.

540. Coat Colors in Horses; Fred Gremel. Journal of Heredity, Vol. 30, No. 10, pp. 437-445, October, 1939.

545. Estimation of Iodine in Soils, Plant Material, and Waters; G. S. Fraps and J. F. Fudge. Journal of the Association of Official Agricultural Chemists, pp. 164-171, February, 1940.

546. Gallatin Petrified Forests; P. A. Young. Bulletin of Torrey Botanical Club, Vol. 67, pp. 121-123, February, 1940.

547. Report on Riboflavin; A. R. Kemmerer. Journal of the Association of Official Agricultural Chemists, Vol. 23, No. 4, pp. 346-351, May, 1940.

549. White-Flower Character Resulting from X-ray Treatment of Tomato Seed; P. A. Young. Journal of Heredity, Vol. XXXI, No. 2, pp. 78-79, February, 1940.

550. The Availability of the Potash of the Soil as Measured by Pot Experiments with Corn; G. S. Fraps and J. F. Fudge. Soil Science Society of American Proceedings, Vol. 4, pp. 205-208, 1939.

552. The Estimation of Units of Vitamin D and Vitamin A in Fish Liver Oils and Their Concentrates; G. S. Fraps, A. R. Kemmerer, W. W. Meinke and S. M. Greenberg. Journal of the Association of Official Agricultural Chemists, Vol. 23, No. 2, pp. 417-422, May, 1940.

553. Report of the Referee on Fertilizers (1939); G. S. Fraps. Journal of the Association of Official Agricultural Chemists, Vol. 23, No. 2, pp. 232-234, May, 1940.

554. Uncontrolled Vegetative Development in Maize and Teosinte; R. G. Reeves and R. H. Stansel. American Journal of Botany, Vol. 27, No. 1, pp. 27-30, January, 1940.

555. Resistance of Tomato Varieties to Blossom-end Rot; P. A. Young. Phytopathology, Vol. 30, No. 1, p. 31, January, 1940.

556. Some Modifications of the Paired-eating Method in Cookery Research —Meat Cookery Research; Sylvia Cover. Food Research, Vol. 5, No. 4, pp. 379-394, 1940.

560. Tomato Fruit Pox; S. S. Ivanoff and P. A. Young. Phytopathology, Vol. XXX, No. 4, pp. 343-345, April, 1940.

562. The Chemistry of Resistance of Plants to Phymatotrichum Root Rot. IV. Toxicity of Phenolic and Related Compounds; Glenn A. Greathouse and Neil E. Rigler. American Journal of Botany, Vol. 27, No. 2, pp. 99-108, February, 1940.

563. The Phenology of Some Bobwhite Food and Cover Plants in Brazos County, Texas; Tandy P. Chenault. Journal of Wildlife Management, Vol. 4, No. 4, pp. 359-368, October, 1940.

568. Effect of Different Environments on Head Shape in Marion Market Cabbage; W. S. Flory, Jr., and J. C. Walker. Proceedings of the American Society for Horticultural Science, Vol. 37, pp. 779-782, 1939.

570. Diplodia Stem-end Rot of Lemons Controlled with Sodium Ethyle Mercuri Thiosalicylate; G. H. Godfrey and W. H. Friend. Science, Vol. 91, No. 2352, pp. 94-95, January, 1940.

573. Crossing Relations of Some Diploid Species of Roses; J. C. Ratsek, S. H. Yarnell, and W. S. Flory, Jr. Proceedings of the American Society for Horticultural Science, Vol. 37, pp. 983-992, 1939.

574. Pruning Unstaked Tomatoes; Leslie R. Hawthorn. Proceedings of the American Society for Horticultural Science, Vol. 37, pp. 930-934, 1939.

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580. The Chemistry of Resistance of Plants to Phymatotrichum Root Rot. V. The Influence of Alkaloids on the Growth of Fungi; Glenn A. Greathouse and Neil E. Rigler. Phytopathology, Vol. XXX, No. 6, pp. 475-485, June, 1940.

583. The Toxicity of Red-Stemmed Peavine *(Astragalus Emoryanus)* for Cattle, Sheep and Goats; Frank P. Mathews. Journal of the American Veterinary Medical Association, Vol. XCVII, No. 761, pp. 125-134, August, 1940.

587. Mineral Deficiencies; Clinical Picture, Treatment and Prevention; H. Schmidt. Journal of the American Veterinary Medical Association, Vol. XCVI, No. 757, pp. 441-458, April, 1940.

588. Fertilizing Value of Spent Phosphate Catalyst; G. S. Fraps. Journal of the American Society of Agronomy, Vol. 32, No. 7, pp. 542-544, July, 1940.

590. An Absorption Method for the Determination of Pure Carotene; G. S. Fraps, A. R. Kemmerer and A. M. Greenberg. Journal of the Association of Official Agricultural Chemists, pp. 659-662, August, 1940.

592. The Synthesis of Nicotinic Acid in the Body of Sheep; A. H. Winegar, P. B. Pearson and H. Schmidt. Science, Vol. 91, No. 2369, pp. 508-509, May, 1940.

593. Early Blackhull Resists Stem Rust in Texas; E. S. McFadden. Phytopathology, Vol. XXIX, No. 7, pp. 644-645, July, 1939.

STATION PUBLICATIONS

Bulletin	Title	Author	Number Pages	Number Copies
577	Commercial Fertilizers in 1938-39 and Their Uses	G. S. Fraps, T. L. Ogier, and S. E. Asbury	59	9,000
578	Commercial Feeding Stuffs, September 1, 1938, to August 31, 1939	F. D. Fuller and James Sullivan	205	9,000
579	Iodine in Texas Soils	G. S. Fraps and J. F. Fudge	25	6,000
580	Mechanical Harvesting of Cotton as Affected by Varietal Characteristics and Other Factors	H. P. Smith, D. T. Killough, D. L. Jones, and M. H. Byrom	49	7,000
581	Chemical Composition of Soils of Cass, Dickens, Falls, Hardeman, Polk, Scurry, and Wheeler Counties	G. S. Fraps, and J. F. Fudge	73	6,000
582	The Chemical Composition of Forage Grasses of the East Texas Timber Country	G. S. Fraps and J. F. Fudge	35	9,000
583	Requirements of Chickens for Vitamin A When Fed as Carotene	Ross M. Sherwood and G. S. Fraps	21	6,000
584	Black Kernel and White Tip of Rice	Alan L. Martin and G. E. Altstatt	14	6,000
585	Poisoning in Sheep and Goats by Sacahuiste (Nolina Texana) Buds and Blooms	Frank P. Mathews	19	7,000
586	Composition and Utilization of Range Vegetation of Sutton and Edwards Counties	G. S. Fraps and V. L. Cory	39	8,000
587	Water and Soil Conservation Experiments at Spur, Texas	R. E. Dickson and C. E. Fisher	67	15,000
588	Values of Various Protein Feeds for Growing Chicks	R. M. Sherwood and J. R. Couch	20	8,000
589	Metabolizable Energy of Some Chicken Feeds	G. S. Fraps, E. C. Carlyle and J. F. Fudge	23	7,000
590	Distribution and Variation of Pocket Gophers (Genus Geomys) in the Southwestern United States	William B. Davis	38	7,000
591	A Population Study of the Gray Squirrel in Eastern Texas	Phil D. Goodrum	34	7,000
592	Bob-white Populations as Affected by Woodland Management in Eastern Texas	Daniel W. Lay	37	7,000
Circulars				
85	Use of Commercial Fertilizers	G. S. Fraps and T. L. Ogier	15	19,153
86	Common Diseases of Tomatoes	P. A. Young, A. L. Harrison, and G. E. Altstatt	31	10,000
87	Rose Diseases	Eldon W. Lyle	16	15,000
88	Abstracts of Bulletins 567-580, Circulars 83-85, and Other Publications During 1939	A. D. Jackson	47	68,000
89	Grape Production in Texas	E. Mortensen and U. A. Randolph	26	10,000
90	Rose Growing for the Home Gardener	J. C. Ratsek	27	15,000
	Fifth-first Annual Report, 1938	A. B. Conner	281	6,000

SUBSTATION NO. 1, BEEVILLE

Substation No. 1, located in Bee County 5 miles east of Beeville, serves a large area of dark colored fertile soils lying in South Texas. Goliad and Victoria soil types predominate in this region. A normal rainfall of 30 inches is fairly well distributed throughout the year, with more of it coming in the winter and spring months. Mild temperatures, with few frosts, prevail; giving an average growing season of 288 days. Normally, second growth and fall planted feed crops can be successfully matured. Green grazing can be had during almost the entire year. All these factors combine to make this region admirably adapted to diversified farming with livestock as a base. With the critical period for plant growth coming in the hot and dry seasons in July, August and September, it seems advisable to turn more attention to the growing of crops during the winter and spring months, when conditions are more favorable for plant growth. With these facts in mind the station is turning more and more attention to finding and developing crops suitable for growing in the winter months.

The chief concern of this station is the development of a profitable land utilization and soil conservation program adapted to this region. Its activities consist chiefly of testing, developing, growing and curing of feed crops and grasses, and utilizing them through beef cattle and sheep; and the testing, developing and growing of profitable cash crops with which to complete a balanced system of agriculture. Some attention is given to the testing of trees and ornamentals for use in landscaping.

Feed Crops

Climatic conditions were rather unfavorable for crop production in 1940, especially for crops maturing early in the year. An accumulated deficiency of 30 inches of rainfall during the past three years, combined with a deficiency of 3½ inches for the first four months of 1940, gave a very depleted soil moisture condition for maturing winter crops and for starting spring crops. A severe freeze in mid-January injured stands of all winter crops. Rains beginning in mid-May and lasting for the remainder of the year aided in securing fair yields of all spring planted crops, except corn. An early frost on November 15 killed second growth sorghums and all late planted sorghums and summer legumes before the crops were matured.

One hundred-ten varieties and strains were included in the corn variety test. The highest yield of 37.0 bushels came from Funk, a northern hybrid crossed on 127 D a Texas hybrid. The twelve highest yields came from Texas hybrids or northern hybrids crossed on Texas hybrids. Golden Thomas, with a yield of 31.9 bushels, was the highest yielding Texas variety. These yields indicate that Texas hybrid corns and Texas hybrids crossed on northern hybrids have some promise in this section. Among the proven Texas varieties, Golden Thomas continues to be the best yielder of good sound corn for this section.

A corn date of planting test contained three varieties planted at four dates. The highest yield of Golden Thomas came from March 1st planting with 23.8 bushels per acre. Highest yields from Surcropper was obtained from March 15 planting with 23.3 bushels. Giant Yellow gave the highest yield of 23.4 bushels from April 1st planting. A period of years summary still indicates that around March 10th is the optimum date of planting corn in this area.

Registered seed of Golden Thomas is grown on the station for distribution to farmers for the production of certified planting seed.

Sorghums: Grain sorghums continue to supply the major feed crops in all of South Texas. Unfavorable curing weather, weevil damage and high cost of harvesting have been large factors in retarding development of feeding operations, based on grain sorghums. These difficulties are being overcome largely by use of trench silos for curing both, forage and threshed grain, and by use of the "combine" in harvesting the grain. Mechanical driers have proven profitable in saving threshed grain for commercial use. The demand is very great for solution of problems constantly arising from these new methods of operation. For the first time the station has cured combined hegari seed in trench silos both with and without the addition of water to the grain. Both methods gave good, well cured feed; however, a little less waste occurred from the trench that was flooded with water at time of filling.

Thirty-seven varieties of grain sorghums, sorgos and grasses were grown in a variety test. Most of the early maturing varieties suffered severely from drouth before the rains started in mid-May. The later maturing varieties had time to recover following the rains and matured a fair crop of grain. Most varieties made below normal forage yields. Second growth was delayed by dry weather and was killed by early frost before a crop was matured. None of it was harvested. The highest yield of grain was produced by Dwarf Hegari, which yielded 49.1 bushels per acre; Maizola yielded 48.7 bushels, and Schrock Kafir 42.3 bushels per acre. Texas Seeded Ribbon Cane gave the highest forage yield with 6.98 tons of cured forage per acre. It was followed by Atlas Sorgo, Sumac and Schrock Kafir in the order named. A period of years summary and general observation indicate that Texas Blackhul and Schrock Kafir are two of the best sorghums for early planting for grain, while Hegari is the best for later planting. Atlas sorgo is especially adapted for an ensilage crop. Quadroon and Double Dwarf Milo are excellent for early planting for quick feed.

A hegari strain test included five strains planted at four different dates. The highest grain yield came from Arizona Hegari, S. A. 278, with 44.2 bushels per acre. It was followed in turn by Hegari 1942, Hegari 61455, Hegari 7313 and Early Hegari. All these highest yields came from April 15th planting. Hegari 61455, gave the highest grain yield from the March 1st planting with 22.1 bushels. From the June 1st planting, Early

Hegari gave the highest yield with 4.4 bushels. Because of dry weather and early freeze no yields were secured from August 1st plantings. Highest forage yields came from June 1st planting. Hegari 61455 gave the highest yield with 4.83 tons cured stover.

Quadroon, Sooner Milo and Hegari were grown in a double cropping test in which an effort was made to determine the proper way of handling stalks after first growth was headed to secure the greatest yield of heads from the second growth. Dry weather after heading of first crop delayed second growth until no heads were matured before the frost on November 15th killed all sorghum growth.

As part of a state wide project to study the effect of light and length of day on maturity of sorghums, fourteen varieties of sorghums were planted at four different dates, beginning with April 1st. Because of dry weather in late summer and fall no germination was secured on the last two dates of plantings. The time between planting date and first bloom date was greater in every instance on the May 1st planting than on April 3rd planting. This difference in time varied from one day for Honey to 18 days for Feterita 811. Stalks were higher and had more leaves on the May 1st planting.

Small Grain: Forty-four oat hybrids, forty-four wheat hybrids, and one hundred thirty-two spring wheat hybrids were planted in the fall of 1939 in a small grain nursery for observation and determination of their resistance to rust in this section. These seed were dry planted in mid-November. Sufficient rains came in December to germinate the seed and a fair stand was secured. Because of dry weather during the remainder of the season very little growth was secured and no yields were recorded. Increase plantings were made in November, 1940, with Victoria oats. Freeze and drouth prevented much growth and very poor yields were secured. Practically no grazing was secured from the oats. 10 acres of Peat Land and Barley suffered the same fate. More grazing, but very little seed was secured.

Grasses: Rhodes and Angleton Grasses planted in 1935 continue to thrive under non-grazed conditions. Dallis grass planted at the same time almost disappeared from the fields. Spring plantings of Rhodes grass made excellent growth and furnished abundance of grazing during late summer and fall. Tewnty-seven sudan strains and crosses were grown in a palatability test. Weather conditions and other conditions prevented accurate data from being secured. Sudan grass was again used in beef production tests. It continues to be the outstanding cultivated grass for this area.

Soy Beans: Fourteen varieties of Soy Beans were grown in a variety test. A fair forage growth was secured, but no seed was produced. Ito-Too-Tan gave the highest yield with 1.65 tons of cured forage. It was followed in turn by Avoyelles, Palmetto, Arksoy and Biloxi. From this and previous tests indications are that soy beans are not a reliable crop for this area.

Cash Crops

Cotton: Cotton continues to be the most popular cash crop for this area. Moisture deficiency in the early part of the season retarded growth, but completely controlled insects. Following the good rains in late May it began to fruit heavily and continued until a fair crop was matured. Harvest season was excellent.

Thirty-six varieties and strains were grown in a cotton variety test. The highest yield was produced by Ambassador with 517 pounds lint per acre. It was followed by Delta Pine Land 44-51 with 482 pounds per acre. Acala Big Boll came third with 458 pounds. All the small boll longer staple cottons made a much better showing than in previous years. In a 10 year average Mebane 804-50 continues to lead the field in average dollar per acre production.

Cotton Date of Planting: Mebane 804-50 and Lankart, two varieties representing different types of cotton were included in the date of planting test. Beginning February 20th these varieties were planted at 10 day intervals up to April 1st. Highest yield of Mebane was secured from the March 10th planting with 500 pounds of lint per acre. This was followed in turn by February 20th, March 1st and April 1st. Lankart also gave the highest yields from March 10th planting with 499 pounds. March 1st and March 20th tied for second place with 433 pounds. April 1st planting gave the lowest yield.

Some hybrids and back crosses of Mebane 804-50 crossed with Lankart were grown in 20th acre plats. Some good yields were secured. In direct comparison with the original strains none of these hybrids or crosses showed improvement over the original strains. Therefore, they are all being discarded.

Broom Corn: Broom corn continues to be second in importance as a cash crop for this area. Only dwarf varieties are grown. Pure seed is one of the most important factors in profitable broom corn production. Texas Scarborough Dwarf, developed by the station is one of the best varieties. Registered seed are produced from it for distribution to co-operating farmers for the production of certified seed. 1940 was a good year for producing broom corn. Showers during harvest season lowered the grade and greatly reduced revenues from the crop.

Flax: Very adverse weather conditions throughout the area retarded the spread of flax growing as a cash crop in South Texas. Dry weather retarded planting two months until January 1st. The 13 degree weather on January 17th killed approximately 50% of the young flax plants. Corn ear worms attacked and destroyed many of the bolls at blooming time. In spite of all these difficulties fair yields were harvested from some fields. Considerable acreage was again planted in the fall of 1940. The flax variety nursery and the rate and date of seeding test were planted on the station, but because of the adverse weather conditions very poor results were secured.

Castor Beans: Five varieties of Castor beans were planted in an observation test. Poor growth was made during the dry spring. Following the May rains some varieties bloomed and set few seed. These were poorly matured during the dry summer and most of them shed before harvest time. Following fall rains a new growth was made and blossoms set. These were killed before reaching maturity. Very poor yields were secured from all varieties.

Fruit Trees and Ornamentals

Because of a severe drouth in the fall and winter of 1939 very little growth was made by the citrus trees. The 13 degree weather in January killed the branches back 8 inches to three feet. Consequently no blossoms were set for the spring of 1940. Rather poor recovery was made by the trees and they went into the winter in a rather poor condition.

Hackberry, Mesquite and Huisache trees continue as leading shade trees for this area. Chinese elms have mostly died from cotton root rot. Ash is used quite extensively in the heavier soil areas.

Tamarix, California and Amur River Privets, Cenizo, Agrito and Pyracantha have proven to be valuable for hedges and for basal plantings. Many other promising native shrubs are being tried.

R. A. Hall and E. M. Neal.

Dried Citrus Peel and Pulp in Ration of Fattening Beef Cattle

In the third test covering a feeding period of 154 days three lots of 10 steer calves each were used. Ground ear corn, Cottonseed meal and Sorgo ensilage were fed to the check lot. Lot 2 received the same ration as lot 1, except that 25% of the corn was replaced with dried citrus pulp and peel. The same ration was used in lot 3, except that 59% of the corn was replaced with dried citrus pulp and peel. The check lot made an average daily gain of 2.19 pounds per steer, while lot 2 made 2.10 pounds and lot 3, 1.90 pounds. Conclusions from the three tests run are that up to 25% of a corn ration can be successfully replaced with dried citrus pulp and peel when prices justify the substitution.

J. M. Jones, R. A. Hall, J. H. Jones, E. M. Neal.

Utilization of Farm Feeds in Beef Production

42 head of well bred hereford calves were purchased in the fall of 1939, weighing 390 pounds. They were grazed on second growth sorghum fields for 52 days during which time they received a supplemental feed of 2 pounds of ground ear corn and 2 pounds of cottonseed meal. A total gain of 107 pounds was secured during this time. The cattle were then placed in dry lot on a ration of 2 pounds ground ear corn, 2 pounds cottonseed meal and all the sorgo ensilage they would consume. During this 156 day period they gained 256 pounds per head and were carrying

fair flesh. On May 1st they were divided into four equal lots and placed on sudan pasture. Lot 1 received sudan grazing only. Lot 2 was self-fed a supplement of 43% protein cottonseed cake. Lot 3 was self-fed a supplement of ground ear corn. Lot 4 was self-fed black strap molasses. Lots 2 and 3 consumed large quantities of the supplement and made similar gains and finish. Both lots were finished beef at the close of the 140 day grazing period. Slaughter data showed yellow color in external fat in most of the carcasses. Lot 4 consumed very little molasses and with lot 1 were not ready for market at close of grazing period. Both lots were placed in dry lot and fed a balanced ration for 56 days at the end of which time they showed about the same finish as lots 2 and 3 had when marketed. This 56 day dry lot feeding period had eliminated most of yellow color in the external fat.

By the method followed in this test much of the waste feeds and cheap roughages can be utilized in producing finished beef at a reasonable cost.

J. M. Jones, R. A. Hall, J. H. Jones, E. M. Neal.

SUBSTATION NO. 2, TYLER

Substation No. 2 is located ten miles northwest of Tyler and five miles southeast of Lindale, Smith County, on Highway No. 69. The elevation is approximately 504 feet above mean sea level. The average rainfall for the past 36 years has been 43.00 inches. The average date of the last killing frost in the spring is March 16, and the first for the fall is November 16. The station farm consists of 455.2 acres of land of which approximately 170 acres are occupied by the East Texas Soil Conservation Experiment Station and operated by the Soil Conservation Service of the United States Department of Agriculture in cooperation with the station. The remaining area is utilized for pasture investigations including the use of dairy cattle, agronomic, horticultural, and plant pathology investigations. At the present time, 43 acres are available for cultivated agronomic and horticultural crops, 150 acres are in cleared pasture, and approximately 95 acres are in woods. In addition, 8 acres are leased for further studies with roses.

The soil is predominantly fine sandy loams of the Kirvin, Bowie and Nacogdoches series, with smaller areas of other series. The leased land is quite uniformly Norfolk fine sandy loam. The topography is quite rolling, with slopes ranging from three to twenty per cent. There is a difference of 159 feet vertical elevation between the low and high points of the station.

The principal problems of this station deal with (1) soil conservation, maintenance, and increase of fertility, (2) the production of various agronomic and horticultural crops, (3) the pathological aspects of rose culture, and (4) the production through breeding and selection of better adapted crops.

Agronomic Investigations
Variety Tests

Cotton: Twenty-four varieties were included in the cotton variety test. Rogers Acala No. 111 produced the highest yield, 568 pounds of lint per acre, followed by Rhynes Cook, Deltapine A, Half and Half, and Hibred with 558, 538, 524, and 517 pounds per acre, respectively. Sixteen varieties have been included for three or more years, of these Rogers Acala, Half and Half, Hibred, Deltapine A, and Rhynes Cook have been the leading varieties. The Rhynes Cook is recommended for locations subject to cotton wilt and nematode infestations.

Corn Varieties and Hybrids: In a test of commercial varieties, commercial hybrids, and Texas Station hybrids, the highest yield was made by a Texas hybrid, 59.8 bushels, which was an increase of 9.1 bushels, or 17.9 per cent, over the best commercial variety. As a group, the Texas Station hybrids averaged 51.1 bushels per acre, the commercial hybrids 47.7 bushels, and the commercial open pollinated varieties 42.7 bushels. The highest yielding commercial variety was Texas Golden Prolific, developed by Substation No. 11 at Nacogdoches.

The following varieties appear to be best adapted from the results obtained during the past ten years: White—Reese Drouth Resister, Surcropper; Yellow—Golden June, Ferguson's Yellow Dent, Giant Yellow, and Yellow Surcropper; Red—Red June. Texas Golden Prolific and Jellicorse, a white variety from Tennessee, have yielded well during the two years they have been grown.

Soy Beans: The regular soy bean variety test consisted of fifteen varieties planted at each of three dates, April 4, May 10, and June 11. Yields of forage averaged slightly below normal during 1940, though though seed yields were somewhat higher. On the basis of their performance during the past eight years, the Avoyelles and O-Too-Tan varieties may be recommended for forage production, but no variety can be recommended for seed.

In a supplemental test of 183 lots including some varieties from different sources and planted in single plat tests, the yields of seed were much better than usual for this section. Nineteen lots produced seed in excess of 20 bushels per acre, 14 lots ranged from 15 to 20 bushels, while 110 lots produced less than 10 bushels per acre.

Castor Beans: Seven varieties of castor beans were grown, but seed yields are not available in time for this report.

Crop Improvement

Texas Seeded Ribbon Cane: A pure line strain of this variety was increased during the year and is now available for limited distribution.

Cowpeas: Further testing and selection among a number of California strains of disease-resistant Blackeye cowpeas has indicated that some of these are well adapted to this section, and show a high degree of resistance to nematode, wilt, and other diseases. A few of the most promising strains were increased for limited distribution. Work was continued toward the production of a fine stemmed, disease resistant, hay type cowpea.

Cotton: The work started in 1939 in the production of a better quality cotton variety resistant to a combination of wilt and nematode was continued.

Soil Fertility Studies

Cotton and Corn: The use of Hairy vetch as a green manure crop preceding cotton in a two-year rotation of cotton and corn will usually suffice for both crops. The use of additional green manure crops preceding corn has failed to affect the yields because of the insignificant growth made by the time it is necessary to plow under for corn. During 1940, the addition of sulphate of ammonia to corn gave increases above the residual vetch treatment of 92 per cent which may be explained by the poor drainage and consequently poor nitrification of the organic material during a season of high rainfall.

The use of Hairy vetch plus 400 pounds of 0-8-4 at the time of seeding the vetch resulted in increased lint yields of 169, 232, and 270 pounds per acre over 400 pounds 4-8-4, oats plus 400 pounds 0-8-4, and no treatment, respectively.

Pasture Grasses: The use of superphosphate alone has failed to appreciably increase the yield of pasture grasses, as measured by clippings. Heavy applications of complete fertilizer increased the yield of grass 85 per cent; 10 tons manure increased the yield by 61 per cent. The application of fertilizers to grass alone can not be considered profitable. Phosphate and phosphate plus manure have given some very good increases when applied to clover seeded on grass sod.

Dairy Cattle

There was no noticeable effect of including lime in the ration of lactating Jersey cows. Two calves which received bone meal added to the salt lick made appreciably better gains than two receiving only salt.

P. R. Johnson.

Rose Investigations

Cultural Experiments: Results of the 1939-40 fertilizer experiments indicated that the greatest response in growth resulted from increments of nitrogen. A 12-9-3 fertilizer used at the rate of 600-pounds per acre gave the best results. Clipping off blooms during the growing season not only reduced the incidence of "die-back" *(Diplodia sp.)* but also reduced materially the injury by cold in a severe November freeze.

Understocks: A new multiflora hybrid resulting from a cross between R. multiflora Welch strain and *Rosa multiflora* Chenault gave promise as an understock for hybrid tea roses. It combines the thornlessness and resistance to black spot of the Welch multiflora and the only partial dormancy of *Rosa multiflora* Chenault. In addition, it seems to root better as a cutting than either of its parents.

Soil Acidification: The use of sulphur as a soil acidifier was found to be very effective in preventing chlorosis of hybrid tea roses. As much as 70-pounds per 100 square feet of soil area on soils where lime content was high was used with excellent results and with no injury to the plants over a period of years.

Pruning of Roses: Results of spring pruning experiments of established plants of Talisman indicated that the more severe the pruning the less the number of blooms during that growing season. Plants receiving no pruning other than the removal of injured and dead wood produced nearly three times as many blooms as plants pruned to 4 inches. Furthermore, blooms of the unpruned plants were of better color throughout the season and as many blooms were carried on long stems as on the 4-inch pruned plants.

Bloom Color of Roses: Studies indicated that the pale color of rose blooms during the summertime was not due to the fading effect of sunshine but because of a lack of available carbohydrates. Defoliation seemed to be the most important single factor to cause fading of bloom color.

J. C. Ratsek.

Rose Diseases

Fungicides for Black Spot Disease Control: The past season was very conducive to the development of black spot, and therefore was favorable for the testing of fungicides. The sulfur-copper mixtures again were more effective in controlling black spot than plain sulfur. In one instance with over 1,500 rose plants, the superiority of 90% sulfur: 10% Tennessee Copper 34 mixture over plain sulfur was measured by increased weight of bushes. With thirteen applications on variety Caledonia, the sulfur: Tennessee Copper 34 mixture increased the weight of the bushes 113 per cent while the increase with plain sulfur (Spider brand) was 38 per cent. In another test using the same fungicides and the same frequency of application but with variety Luxembourg, the sulfur-copper mixture caused an increase in weight of 88 per cent while sulfur alone was responsible for a 50 per cent greater weight than where no fungicide was used. Fungicide applications were not begun until symptoms of black spot were evident.

Ten per cent of two hundred mesh potassium permanganate with 90 per cent of 325 mesh sulfur (Swan brand) did not improve the effectiveness of the sulfur in controlling black spot.

The black spot disease again was shown to be satisfactorily controlled by fungicides when applications were withheld until symptoms of the dis-

ease appeared. Using eighteen applications of 90% sulfur: 10% Cuprocide GA dust mixture, black spot in a planting of 164 hybrid teas of several varieties was reduced from an average of 4 infected leaflets per plant on April 16 to 1.1 on October 20, 1940.

The following spray treatments are listed in order of effectiveness in a test for black spot control with roses, variety Caledonia: (1) Cupro-K; (2) Cuprocide 54Y; (3) Mike Sulfur; (4) Palustrex Sulfonate-B.

Die-back Disease: Die-back in most rose plantings was prevalent due to the severity of the black spot disease. Inoculations with the *Diplodia sp.* of fungus were only moderately successful in causing a die-back condition with roses, variety Luxembourg, which were vigorous in growth due to effective treatment to control black spot.

Crown Gall Disease: Colchicine was ineffective in controlling crown gall when used on rose roots at 1:10,000 concentration as a dip, as a 10 minute soak, or as a 30 minute soak. Neither did it prevent further development of galls when a 2 per cent solution was brushed on the galls. Removal of galls followed by dipping the roots in a 1:10,000 solution of colchicine did not inhibit the redevelopment of crown gall.

Root Knot Control: A preliminary test gave indications that the hybrid rose understock *Rosa multiflora* x *blanda* may be resistant to infection by the root knot nematode. *R. caudata* also showed some degree of resistance.

Eldon W. Lyle.

Soil and Water Conservation Investigations

(In Cooperation with the Conservation Experiment Stations Division of the Soil Conservation Service, U. S. Dept. of Agri.)

The most important conservation problem of the area is the conservation of the topsoil and the maintenance of soil fertility.

The principal work of the Conservation Experiment Stations Division at the Tyler station to date has been the measuring of surface run-off and soil loss in run-off from control plots, terraces and fields under different conditions. The effect on soil and water losses of such factors as vegetative cover, degree of slope, length of slope, soil series, burning of wooded areas, crop rotations with winter cover crops, and terracing including grade, spacing, and length are being studied.

There follows a brief review of some of the problems under study.

Control Plots

The information obtained from control plots is comparative for different agricultural practices and treatments. The results obtained serve as indicators in the development of erosion-control methods. In addition, information is obtained which relates to the fundamentals underlying the causes and effects of erosion.

Some of the results to date are as follows:

1. **The effect of plant cover.** The results over a period of years show uite conclusively that Bermuda grass sod and native forest cover for all ractical purposes prevent soil and water losses; however, the problem is ot solved because all land cannot be planted to grass and trees.

2. **The effect of slope characteristics.** The results have shown a definite ıcrease in soil loss with an increase of slope grade and slope length. An ıcrease in slope length has not shown any material increase in percentage f water loss as surface run-off.

3. **The effect of soil series.** This study includes Nacogdoches and Kirvin ›ils in both their normal topsoil and subsoil. The results show that acogdoches soil, both topsoil and subsoil is less erodible than Kirvin with uniform crop and cultural treatment.

4. **The effect of burning of wooded areas.** The results over a period of ears have shown that the practice increases both soil and water losses. he losses have increased from year to year.

5. **The effect of a crop rotation with a winter cover crop of vetch.** three-year rotation of cowpeas, cotton, and sorghum with a winter cover rop of hairy vetch in comparison with continuous cotton as a check is used ı this study located on Kirvin soil with a land slope of 8.75 per cent. he continuous cotton without a cover crop lost an average of 25.67 tons of ›il per acre, whereas the average soil loss per acre on the rotation with a inter cover crop of vetch was only 16.32, a decrease of 9.35 tons or a ecrease of 36 per cent in soil loss.

6. **Cowpeas in cropping system rank high as soil and water saving crop.** omparative data during a complete cycle of treatments of three plots ver a period of 24 months during 1938, 1939 and 1940 where a comparison f soil and water losses were made on cowpeas, cotton, and sorghum with cover crop of vetch gave the following results:

Treatment		Surface Run-off Cu. Ft.	Soil Loss Pounds	Rainfall Producing Run-off Inches	Surface Run-off	
Crop	Plot Dimensions Feet				Inches	Per Cent
›wpeas	6x72.6	363.95	308.72	66.76	10.026	15.02
›tton	6x72.6	478.97	823.09	66.76	13.195	19.76
›rghum	6x72.6	408.89	398.38	66.76	11.264	16.87

Terraces and Watersheds

Not only was the year 1940 outstanding for the large total amount of ıinfall but several storms of very high intensities were also recorded.

The soil losses on the unterraced watershed completely reversed the trend f the past three years and again widened the margin between the aras

under terrace control. In fact, the data reveal an approximate 35 per cent increase in the soil losses from the unterraced watershed over its previous high. This loss reached a total of approximately one and one-quarter million pounds of soil from the 6.05-acre unterraced field amounting to 100 tons loss per acre, about 2½ times the 7-year average.

In contrast to the unterraced cultivated watershed, the wooded watershed had light soil losses and were within range of its seven-year average. Ten periods of very light run-off were recorded from the wooded watershed compared with thirty-four from the unterraced watershed, only five of which could be classed as light.

Soil and water losses from the strip-cropped watershed were also high and gully formations were more numerous and serious than on the terraced areas. However, it appears that these losses were not prohibitive and that the true test of strip cropping on this comparatively steep and somewhat gullied area will come within the next two or three years when it demonstrates its ability to recover.

All terraced areas performed very satisfactorily. The open end level and minimum graded terraces again demonstrated their ability to conserve soil and water and to hold crop losses from drowning to a minimum.

Perhaps the most noteworthy accomplishment of the year was the construction of five terrace intervals with parallel terraces which will give replication of terraced areas under measurement for the first time.

SUBSTATION NO. 3, ANGLETON

Substation No. 3 is located 3.1 miles northeast of Angleton, Brazoria County, adjacent to the St. L., B. & M. Railroad. The latitude is 29 degrees north and the longitude 95 degrees west with an elevation of 23 feet above sea level. The Station is located in the Gulf Coast Prairie region and the soils are of the Lake Charles and Edna series. The topography is flat with slow drainage. The average annual rainfall over a period of 27 years was 45.59 inches as compared with 45.32 for 1940. The maximum temperature for a period of 27 years was 105 degrees F. and the minimum temperature for the same period of time was 10 degrees F., as compared with 99 degrees and 10 degrees, respectively, for 1940. The month of January, 1940, was the coldest month on record at this station. The average relative humidity for a period of 26 years was 79.7% and the average annual evaporation for the same period of time was 44.710 inches. The average date of first killing frost in the fall is December 1 and the last killing frost in the spring is February 27, giving an average growing season of 275 days.

The growing season of 1940 was characterized by a dry spring with a late killing frost on April 13, a dry summer and fall but heavy rainfall from the last of October to the end of the year. The January freezes with the dry weather the most of the year made pastures very short in

his section. The prairie hay crop was one of the shortest on record. he corn crop was above the average this year and the cotton crop was ne of the best on record. An early freeze, November 15, injured late rain sorghum.

otton

Eighteen varieties were grown in the regular cotton variety test in 940 and twelve varieties were grown in a supplemental variety test. he stand on the supplemental variety test was spotted and the yields annot be considered reliable. The stands were fairly good on the regular ariety test and the yields should be reliable. D & P L 11A again made he highest yield in the variety test in 1940 with 890 pounds of lint otton per acre followed in order by Stoneville 2B, Stoneville 5A, Hi-Bred nd Washington (Delfos 719) with 863 pounds, 835 pounds, 824 pounds nd 811 pounds of lint cotton per acre. During the past six years D & P L 1A has made an average yield of 509 pounds of lint per acre followed y Stoneville 5A, Rogers Acala, Oklahoma Triumph, New Boykin and Vatson with yields of 452 pounds, 439 pounds, 414 pounds, 405 pounds nd 381 pounds of lint cotton per acre. D & P L 11A is a very popular ariety in this section. Rogers Acala is being widely grown also and a good spinning cotton.

The breeding work with cotton consists of crosses between D & P L 1A with Rogers Acala and with Mebane 804-36, together with back-rosses of the above hybrids on D & P L 11A. Several years will be equired to determine the value of any of the selections from these crosses.

orn

In the corn variety test 26 varieties and named commercial hybrids nd 28 other hybrids were grown. The highest average yield in the test as made by a cross of Yellow Surcropper and 132A, a Texas inbred ne, with 50.6 bushels of shelled grain per acre. Surcropper produced yield of 50.2 bushels per acre. The early varieties were not injured as everely by the hot dry weather in June as were the late varieties. The orthern hybrids did not make higher yields than the best Texas ommercial varieties and had more weevil damage. Some of the Texas ybrids show good promise for this section.

Of the varieties tested for a number of years White June, Red June, olden June, White Surcropper, Yellow Surcropper and Reese's Drouth esister are recommended as early varieties for this section and White uxpan and Yellow Tuxpan are the best late maturing varieties.

The corn breeding work consists of inbreeding Yellow Tuxpan for the roduction of high yielding hybrids, the production of a Red Cob Yellow uxpan, a Sweet Yellow Tuxpan and a strain combining Yellow Surcropper nd Yellow Tuxpan characteristics.

Schrock Kafir

Schrock Kafir is the outstanding variety of grain sorghum at this station. In a comparison of Schrock Kafir and Yellow Tuxpan corn for grain yield in 1940 Schrock Kafir produced 36.4 bushels per acre as compared with 25.1 for corn. In a twelve year average Schrock has produced an average of 25.6 bushels per acre as compared with 18.1 for Tuxpan corn. Schrock has a high tannin content and the tight glumes makes it resistant to bird damage. The loose heads prevent much mold and head worm damage in this region. Schrock can be planted until August 1 and make a good seed crop.

A number of promising selections from Schrock Kafir have been obtained at this station. Some of the types are dwarf, some are tall, some have a pithy stalk and some have sweet juicy stalks, but all have an open type of head and produce good grain yields. Some of these selections should be ready for distribution in a year or two.

Forage yields of Corn, Sunflower and Sorghum varieties

Orange made the highest yield of air-dry forage in 1940 with 9.67 tons per acre followed in order by Red Top, Schrock, Hegari, Amber, Corn and Sunflower with 6.47 tons, 6.36 tons, 5.08 tons, 4.56 tons, 2.58 tons and 2.27 tons per acre respectively. For the past seven years Orange has produced an average yield of 5.40 tons of air-dry forage per acre followed by Schrock with 4.47 tons and Red Top with 4.34 tons. Schrock produces more grain than Orange or Red Top. Orange produces three cuttings during many years.

Wheat and Oats Rust Nursery

The small grains were injured by the January freezes and the dry spring weather. The new rust resistant wheat strains produced over twice the yield of some of the old commercial varieties this year although there was little rust this year. The spring wheats were not as productive as the winter wheats.

There was very little rust on the oats this year and the yields were fair. Many of the rust resistant strains produced around 40 bushels per acre as compared with 22 bushels for Victoria, 32 bushels for Country Common, 33.2 bushels for Bond and 33.8 bushels for Alber.

Flax

The minimum temperature of 10 degrees in January killed almost all the plants of most of the commercial varieties of flax planted at this station including Bison and Rio the varieties being grown commercially in Texas. The most of the hybrids between Bison and Rio showed good survival after the freeze. One new variety Turkey C. I. No. 862 grown for the first time this year had a 90% survival after the freeze. This variety is irregular in its maturity but has great possibilities for breeding winter hardiness into some of our better varieties.

oy Beans

Sixteen varieties of soy beans were grown in a variety and date of eeding test. The plantings were made on April 4, April 17, and May 3. ll stands were good. There was no consistent difference in the yields f the various varieties for the three dates of planting. The highest verage forage yield for all three dates of planting was made by O-too-tan ith 1.93 tons of air dry forage per acre followed by Avoyelles, Palmetto nd White Biloxi with 1.74 tons, 1.68 tons and 1.42 tons per acre respec-ively. There was little difference in seed yield at the various dates of lanting. The seed yields were better than average this year. Manchu ade the highest average seed yield for all three dates of planting with 94 pounds of seed per acre followed by Avoyelles, Macoupin and O-too-tan ith 449 pounds, 437 pounds and 355 pounds per acre respectively. For he past five years Laredo and O-too-tan have been the highest yielders f forage and Avoyelles and O-too-tan have been the highest yielders of eed although the seed yields have been low, Avoyelles producing an verage of 268 pounds of seed per acre.

In an inoculation and rate of seeding test with Mamredo soybeans in-culation has had little effect on forage or seed yields. The seeding rate ad no effect on seed yields but the 20 pound seeding rate produced less orage than the 30 pound, 40 pound or 50 pound seeding rate.

Winter Legumes

Four varieties of winter legumes were grown on bedded and flat land nd with and without 40 pounds of Phosphoric acid per acre. This test as been conducted for two years. The Phosphoric acid has increased the ield of all the legumes in the test. The method of soil preparation has ad little effect on the yield. The legumes grown in this test are Yellow Annual Sweet Clover, Hubam Clover, Alsike Clover and Hairy Vetch.

Castor Beans

Five varieties were grown in 1940. The yields this year were much ower than in 1939. USDA No. 4 again produced the highest yield in 1940 ith 318 pounds of clean seed per acre as compared with 805 pounds in 939. Dry weather injured the crop this year.

Okra for Seed

Three varieties of okra were grown in 1939 and in 1940. All the pods re allowed to mature on the stalk and the entire stalk is harvested and hreshed. This system would require very little hand labor and could be sed on a large scale with labor saving machinery. White Velvet shatters ess than the other varieties grown, Perkins Long Pod and Dwarf Green, nd produces the highest yields of seed. Its average yield of seed was 96 pounds during the last two years.

Fertilizers

The fertilizer test with corn and cotton was continued this year as in previous years. Using a 4-12-4 mixture at 400 pounds per acre as a basis, each fertilizing element was varied independently. Several 800 pound applications were used and the 4-12-4 mixture was applied at rates of from 200 to 1000 pounds per acre. Nitrogen and Phosphoric acid are the chief needs of the Lake Charles soils of this section. The fertilizers were not effective on corn this year due to the very dry weather. The response from cotton was less than usual, the no-treatment plats producing an average of 751 pounds of lint per acre while 800 pounds of an 8-12-6 fertilizer produced only 968 pounds of lint. Phosphoric acid was of no value except when applied with nitrogen under cotton. Large applications of potash under cotton have had little effect on the yield.

A pasture fertilizer test on a carpet grass sod was started in 1936 and the fertilizers are applied to the surface of the sod each year. The January freeze killed out part of the grass and the dry spring and summer reduced the growth. The no-treatment plat produced 1345 pounds of air dry clippings as compared with 2228 pounds for an 0-80-0 application and 2370 pounds for a 40-80-0 application. The phosphoric acid has greatly increased the White Dutch Clover growth and the response from nitrogen applications has been less each year. A duplicate test was set up in 1939 using the same fertilizers which were applied in 1939 only and then thoroughly disked in. The fertilizer application was made on March 14 in 1939 and a dry spring resulted in the destruction of most of the grass on these plats. No seeding was done and the first yields were obtained in 1940 from the grass that volunteered and survived on these plats. The no-fertilizer plats produced the highest yield in 1940 although there was little difference in any of the yields. This test will be continued for several years.

Time and Method of Seedbed Preparation Test

This project was started in 1932 and the land is prepared in the fall or spring or both and either bedded, flat broken or a combination of both. All combinations of these methods are used and corn and cotton are grown in a three year rotation of two years cotton and one year corn. The fall preparation is made as soon after the crops are harvested as possible and the spring preparation is made as soon after Feb. 1 as soil conditions will permit. The lowest yield in 1940 was made by spring flat breaking for both cotton and corn. The lower yields made with this method of preparation appears to be due to the poorer stands obtained. There is little difference in yields except as reflected in the stands obtained during the time this test has been conducted.

Cotton Green Manure Test

A cotton green manure test was started in 1937 using annual Yellow Sweet Clover as a winter green manure crop and using a 4-8-4 fertilizer

f which two-thirds of the superphosphate was applied in the fall on some lats and all the fertilizer in the spring on other plats. The object is to etermine the effect of the fall fractional application of the phosphate on ne clover growth and to determine their combined effect on the succeeding otton crop. The fall application of part of the superphosphate has failed o increase the growth of clover and the clover must be plowed under efore it has made much growth in order to get the cotton planted in fficient time to make a normal crop. The fall fractional application of ne phosphate has reduced the cotton yield. A combination of fertilizer pplied in the spring with clover produced 711 pounds of lint cotton per cre in 1940 as compared with 579 pounds of lint with the same treatment xcept two-thirds of the phosphate was applied in the fall and 649 pounds f lint where all the fertilizer was applied in the spring with no clover. he check plat with no clover or fertilizer produced 471 pounds of lint as ompared with 589 pounds of lint with clover and no fertilizer.

otation Studies

Cotton, corn, Schrock Kafir, and cowpeas have been grown in various otations with and without legumes and with and without fertilizers. The inter legumes in the rotations increased the yield of the crops. Cowpeas n a three year rotation and harvested for hay increased the yield of the ther crops in the rotation. A 4-8-4 fertilizer increased the yield of corn r cotton in a three year rotation of cotton, cowpeas and corn but did not ncrease the yield on plats planted each year to cotton or corn since 1913. otated cotton without fertilizer produced 546 pounds of lint per acre as ompared with 495 pounds on the non-rotated cotton while the yield of orn was 37.7 bushels and 25.9 bushels respectively.

R. H. Stansel.

Horticultural Work

rapes

The Carman, Chasselas de Fountainbleau, Manito, Zinfandel and Muscat arieties in the grape test which appeared to have diminished in vigor st year were completely killed by the freezing weather in January, 1940. nly two varieties produced grapes this year. These were Black Spanish ith a yield of 8708 pounds, and Lomanto with a yield of 3884 pounds per cre. The total soluble solids were higher and the acid content was lower is year than last year on these two varieties. Champanel made a very ood growth but produced no fruit.

ther Fruit and Nut Variety Tests

No yields were obtained from strawberries, peaches, pears, plums, dew nd black berries, Satsuma oranges or Meyers lemons because of the reezing weather in January, 1940. The 1940 pecan yields were the largest this test but all yields were low. Mayhan has done remarkably well

since these trees were top worked in 1935. Pecans cannot be considered profitable as a commercial crop on these prairie soils.

H. M. Reed, R. H. Stansel.

Fig Breeding Work

Pollen from A Boise Jaspee, Hamma, and Roedings No. 3 capri figs remained viable for 3, 15 and 20 days respectively when stored at room temperature and for 105, 105, and 99 days respectively when stored at a temperature of 47° F. Hamma pollen which was kept in a desiccator over sulfuric acid and under 20 inches of vacuum for 10 days, then removed and sealed in air tight containers, remained viable for 75 days when stored at room temperature and for 104 days when stored at a temperature of 47° F. The viability tests were made by artificially pollinating Magnolia figs with the pollen under test at definite intervals and recording the numbers of figs which were caprified.

Twelve seedlings from crosses previously made bore fruit this year. One of these varieties was thought to have some possibility as a shipping fig. The fruit was greenish yellow in color, 28 per pound in size, well shaped and with a solid body, small blossom end opening, and with a rather thick and slightly tough skin which should make it fairly resistant to bruising.

H. M. Reed, S. H. Yarnell.

Fig Products Investigations

Figs in the variety orchard started to set fruit on March 9, which was considerably later than last year. About 75 varieties produced mature fruit. The date of maturity on these varieties ranged from July 1 to October 25. Bourjassotte Grise made the best yield with an average of 59.18 pounds per tree, followed by De Grasse with 52.42 pounds, D'Agen with 42.28 pounds, Bourjassotte with 37.59 pounds, and Negro Largo with 24.83 pounds. Other varieties ranged from this point to as low as .16 pounds per tree. These yields are based on usable figs.

In the drying tests with 18 varieties Royal Vineyard had the highest quality rating with a good to excellent. D'Agen, Hunt, Green Ischia, and Celestial all had a rating of good. Royal Vineyard was good to excellent in appearance and Hunt and Celestial were good. Royal Vineyard and Green Ischia were good to excellent in texture and Magnolia, de L'Archipel, Bourjassotte Grise, Dr. Hoggs Claire, Gentile, Precoce de Barcelona, Negro Largo, D'Agen, Hunt, Celestial, and Bourjassotte Blanche were all good in texture. Green Ischia had a good to excellent flavor and Magnolia, de L'Archipel, Reculver, D'Agen, Hunt, Celestial and Royal Vineyard all had a good flavor. Royal Vineyard had the highest percentage of No. 1 figs with 67.0% and Negro Largo the lowest with 0.0%. The moisture content varied from 18.27% to 21.67% and the SO_2 content from 108 to 1345 ppm. Processing the figs for 2 minutes in boiling water

pulling, and brick packing under slight pressure improved the appearance considerably on those samples which were treated.

Among the 22 varieties which were made into lye peeled preserves Magnolia, Gentile, De Constantine, Dr. Hoggs Claire, Negro Largo, de L'Archipel, Royal Vineyard, Smyrna and Maslin capri and Bianco Grosso all had a quality rating of good. Smyrna by Maslin capri was good to excellent in appearance; Magnolia and Violette de la Frette were good to excellent in texture, and De Constantine and Dr. Hoggs Claire were good to excellent in flavor.

Among the 39 varieties which were made into unpeeled preserves La Madeline, Monstrifuse, Bianco Grosso, Smyrna by Maslin capri, Violet Sepor, and Pauly's No. 2 all had a quality rating of good as compared to fair to good for Magnolia. None of these samples were better than good in appearance and most of them varied from poor to fair to good. La Madeline and Bianco Grosso were good to excellent in texture and the other samples varied from fair to good. Except for a Boise Jaspee, Hamma, and Peau Dure which were fair to poor, all of the samples varied from fair to good in flavor.

Among the 53 varieties which were made into breakfast figs Magnolia, Bourjassotte, La Madeline, Bianco, Grosso, Lemon, Cordelia, Smyrna, Violet Sepor, Williams, Pauly's No. 2 and Pauly's No. 1 all had a quality rating of good. None of the samples were better than good in appearance. Cordelia and Smyrna were good to excellent in texture and Smyrna was good to excellent in flavor.

H. M. Reed.

Grape Juice Blending Experiments

A comparison of the analysis of 24 samples of grape juice soon after pressing and after 8-9 months of storage showed an average decrease of 73% total soluble solids and an average decrease in acidity of .22%. From the 41 samples of straight and blended juices the following were judged to be good or better in average quality rating. Good to excellent: America, Commercial Concord. Good: 25% Carman plus 25% Virginia plus 25% Fern Munson plus 25% America; 75% Virginia plus 25% Catawba; 25% Carman plus 75% Virginia; 75% Carman plus 15% Virginia plus 10% Mustang; 50% Carman plus 25% Virginia plus 15% Catawba plus 10% Mustang; 75% Carman plus 25% America. Mustang juice in which the acidity had been reduced to .85% by the addition of Calcium Carbonate and the total soluble solids increased to about 18% by the addition of sugar was also good in quality. The average quality rating on most of the blends which were repeated from last year was lightly lower this year. Preliminary tests on the preparation of concentrates from the straight juice and blended juice samples indicated that sirups or concentrates of good flavor can be prepared from these juices. None of the juices tested contained enough pectin or pectin of sufficiently high jellying power to

make jelly. This indicated that if it is desired to make jelly from Texas juice which was prepared for beverage purposes it will be necessary to add pectin. Preliminary tests were made on the preparation of jelly from several varieties of grapes and also upon the effect of temperature and the time of extraction on the color and analysis of the juice the results of which will be reported upon at a later date. Juice characteristics were determined on 62 varieties of grapes obtained from the Fruit Laboratory at Montague, Texas. On these varieties the period of maturity varied from July 15 to August 28, the color of the juice from Amber to deep purple, the total soluble solids from 7.94% to 26.38% and the acidity from .54% to 2.66%. There was a tendency for the late maturing varieties to be lower in acid and higher in total soluble solids than the early maturing varieties.

H. M. Reed, U. A. Randolph.

Anaplasmosis in Cattle

A survey made during the year indicates there are at least nine species of ticks in Texas which infest cattle in nature in varying degrees of frequency and that the probable normal range of distribution for the majority of these species is composed of the southeastern half of the state. Counties from which authentic reports of anaplasmosis have originated during the past few years are likewise in this section.

All completed tick transmission studies have terminated with negative results. Five different species have been used in the studies this year.

Observations made on repeated tick feedings reveal that bovine hosts may develop some acquired immunity to the genus *Amblyomma*, the duration of which has not been determined.

By subcutaneous injection it was found that the abdominal contents of one fly, *Tabanus atratus*, remained infective 6 hours after engorgement on an anaplasmosis carrier animal but not 20 hours or 48 hours after engorgement. This would indicate that if *T. atratus* is a natural agent of transmission, the probable role played is that of a mechanical vector.

Efforts to induce captive mosquitoes to feed on guinea pig, bovine, and human hosts have been unsuccessful. Maintenance on sugar solution is, however, readily effected.

Sodium cacodylate therapy has proven unsuccessful in the treatment of two clinical cases of anaplasmosis in aged cattle. The opportunity to study treatment more extensively has not arisen.

P. L. Piercy.

The Relationship of the "Gulf Coast Ear Tick", *Amblyomma maculatum*, to Screw Worm Infestation in Livestock and Methods for Its Control

A project designed to investigate this problem was approved for study at this station late in the year. A preliminary survey has been made of

ne probable extent and seriousness of the problem. It appears probable nat most of the Gulf coast area for approximately 75 to 125 miles inland ; the most naturally and heavily infested district.

The only wildlife examined during the year were two rabbits and one ieadowlark each of which was found to be infested with from one to five arval or nymphal specimens of the genus *Amblyomma*. Although the pecies could not be definitely identified it appears highly probable that ne infestation was one of *Amblyomma maculatum*.

P. L. Piercy and C. A. Woodhouse.

Toxemia Among Cattle of the Gulf Coast Area of Texas Project 458

During the year four outbreaks of this condition were encountered and nvestigated on various ranges in this area. Intestinal material from affect-d animals was cultured under anaerobic conditions and the presence f toxins were demonstrated by inoculating small and large experimental nimals. Two experimental cows were injected with cultural material ecured from the small intestines of field cases, one animal was injected ith whole culture and the other with culture filtrate. Both animals showed ymptoms and post mortem findings similar to those found in field cases. rom the liver of one of these large experimental animals a very virulent naerobic organism has been isolated and is now being studied.

The ground green bones of a range animal that died from this condition as fed at the rate of ½ pound daily over a period of thirty days to an xperimental cow with negative results.

J. J. Reid, H. Schmidt.

Keratitis of Cattle

This project was approved during the latter part of Oct. and since no eld material was available during the latter part of the year work will ot get under way until early spring when the necessary field material ecomes available.

Laboratory preparations have been made for the mode of attack towards ne solution of this problem and suitable quarters are now being made vailable in the Pathological barn to care for experimental animals that ill be involved in this work.

J. J. Reid, H. Schmidt.

Investigation of Gastro-Intestinal Parasites in Cattle

A preliminary survey has been made of the species of gastro-intestinal arasites infecting cattle in the Gulf Coast Area. Fifteen species of para-tes, representative of thirteen genera, were found parasitic in the di-estive tube or its diverticula. They are: Esophagus, *Gongylonema ulchrum;* Rumen, *Cotylophoron cotylophorum;* Abomasum, *Haemonchus*

contortus, Ostertagia ostertagi, Trichostrongylus axei: Small intestine, *Bunostomum phlebotomum, Cooperia punctata, C. pectinata, Trichostrongylus colubriformis, Capillaria brevipes, Moniezia expansa, Linguatula* sp. (larva); Large intestine, *Trichuris ovis, Oesophagostomum radiatum;* Liver, *Fasciola hepatica.*

In two instances estimates were made of the number of gastro-intestinal parasites present in cows that had died of parasitic gastro-enteritis. In one case a total of 121,713 gastro-intestinal parasites was estimated, while in another the estimate was 110,102 parasites.

An infection plot is being established to study the infectivity and survival of nematode parasite larvae under range conditions. Also some work is being done with anthelmintics in cattle. However, sufficient progress has not been made to warrant reporting at this time.

C. A. Woodhouse, J. J. Reid, H. Schmidt.

SUBSTATION NO. 4, BEAUMONT

Substation No. 4 is located six miles west of Beaumont. The 100 acres of land consists largely of Lake Charles and Crowley clay which are representative soils of the rice-growing region of the State.

Climatic conditions were rather unusual during the past year. The total precipitation of 57.62 inches was 5.02 inches above the average. The normal growing season is 22 days longer than the 245 recorded this season. The temperature dropped to 32 degrees or lower on 26 days during the first months of the year. This was approximately three times the normal number. A heavy rainfall with a windstorm on August 7 and 8 resulted in severe damage to cotton and corn crops on this station and surrounding locality.

Rice Investigations

(Cooperation with the Division of Cereal Crops and Diseases, Bureau of Plant Industry, U. S. Department of Agriculture)

Variety Test

Twenty-two varieties, 10 of which were of hybrid origin, were grown in replicated field plats in 1940. In the early maturity group a selection from Colusa x Blue Rose and Zenith gave higher yields than Edith, Early Prolific, and Lady Wright. The average yield of Zenith, for the four-year period 1937-1940, was 38.1 bushels per acre as compared to 34.0 bushels for Early Prolific. Because of its superior yield and grain quality Zenith can be recommended for commercial production in place of Early Prolific. In the midseason maturity group Fortuna, Shoemed, and Nira were the highest yielding varieties. In the late maturity group three selections from Kameji x Blue Rose all gave higher yields than Blue Rose. These selections mature about 10 days earlier than Blue Rose and are resistant to the Cercospora leaf spot disease to which Blue Rose is highly susceptible.

urther testing will be required to determine whether these selections re worthy of commercial production. A selection from Rexoro x C. I. No. 094, that resembles Rexoro in grain type but matures approximately two eeks earlier, yielded slightly higher than Rexoro. This selection appears o have considerable promise both from the standpoint of yield and time f maturity. A small acreage will be grown on farms in 1941.

H. M. Beachell, P. P. I., and R. H. Wyche.

ice Breeding

The rice breeding program has consisted principally of making selections om hybrid material. Of the 237 varieties and strains tested in field and ursery yield plats in 1940, 164 were of hybrid origin and were selected rgely from the breeding nursery on the station. Some promising selec- ons similar to Blue Rose in grain type and more resistant to the *elminthosporium oryzae* and *Cercospora oryzae* leaf spot diseases have een isolated. In 1935 a hybrid selection highly resistant to *Cercospora yzae* and also more resistant to *Helminthosporium oryzae* than any aterial previously available was crossed with Blue Rose. The F_1 plant f this cross was backcrossed to Blue Rose in 1937. The progenies from ese backcrossed lines have given Blue Rose types highly resistant to *ercospora oryzae* and they also possess more resistance to *Helminthospo- um oryzae* than does Blue Rose. The milling quality of a number of ese lines is being determined and the better ones will be tested in yield ats in 1941.

H. M. Beachell and E. C. Tullis, B. P. I.

ertilizer Tests

Rates and Combinations: Nitrogen and phosphoric acid were applied eparately and in combinations of varying amounts. A light application f phosphoric acid was just as beneficial as a larger amount. As the mounts of nitrogen were increased the yields, also, increased in pro- ortion. However, the heaviest yield of 3158 pounds of rice per acre was btained from a combination of 40 pounds of nitrogen and 20 pounds of osphoric acid per acre. This was an increase in yield, over the untreated il, of 973 pounds per acre.

Sources of Nitrogen and Phosphoric Acid: Nitrogen was applied at e rate of 20 pounds per acre using six different materials as sources f this element. Five different materials were applied at rates to furnish pounds of phosphoric acid per acre. The results indicate very little fference in the value of the materials in either case. However, the largest crease in yield, 957 pounds per acre, was obtained by a combination lfate of ammonia and nitrate of soda used in amounts to furnish 10 ounds of nitrogen from each material.

Methods of Applying Fertilizers to Rice: Nitrogen and phosphoric id were applied separately and in combination on top of the soil and the drill with the seed. Phosphoric acid alone increased the yield 14.9

per cent when applied on top of the soil and 5.1 per cent when drilled in with the seed. Nitrogen alone increased the yield 21.0 and 22.5 per cent, respectively. An increase of 21.3 per cent was obtained from a combination of the two applied on top of the soil, and an increase of 36.4 per cent by drilling them in with the seed.

Cooperative Fertilizer Tests: Tests were conducted on farms in Orange, Jefferson, and Liberty Counties to determine the general fertilizer requirements for rice in the different localities. The results indicate that phosphoric acid is very beneficial in Orange County. It was superior to nitrogen in Liberty County, and of very little value in Jefferson County when used alone. Nitrogen alone was of very little value excepting in Jefferson County. In each case a combination of nitrogen and phosphoric acid was of more value than either alone.

Sulphur on Rice Soils in Cylinders: This is a continuation of the study on the tolerance of rice plants to various degrees of acidity and alkalinity. There was a noticeable difference, from 4.5 to 7.5, in the ph readings of the soil in the various cylinders before the application of the irrigation water. Shortly after the irrigation water was applied there was a noticeable rise in the ph of the soils that showed low readings in the earlier part of the season, and a lowering of those that were high at the earlier date. The largest yields of both grain and straw was produced by the soil having the lowest ph readings.

R. H. Wyche.

Cultural Tests

Rates of Seeding: Blue Rose rice was seeded at rates of 60, 80, 100, 120, and 140 pounds of seed per acre. Four replications received no fertilizer, and four received a combination of nitrogen and phosphoric acid. Conditions were very favorable for germination of the seed. In each case the lowest yields were obtained from the heaviest rates of seeding and the largest from the lightest rates of seeding.

Rotations: This test includes eight different two-year rotations. The two largest yields obtained this season were from the rotations of summer fallow and pasture during the years the land was not in rice. The plats cropped to row crops did not produce any noticeably larger yields than the ones cropped continuously to rice.

Variety and Date of Seeding: Fifteen varieties and hybrids were planted at 20-day intervals from March to June 10. The earlier seedings produced larger yields of grain than the ones made on May 20 and June 10. The difference in yields from the different dates of seeding were greater with the varieties that are late in maturing. The extremely late maturing varieties produced very light yields when seeded late in the season.

R. H. Wyche.

seases of Rice

The most common diseases found on rice in Texas in 1940 were *Hel-nthosporium oryzae*, *Piricularia oryzae*, *Cercospora oryzae* (rotten ck), and *Tilletia horrida* (kernel smut). Helminthosporium leaf spot as more prevalent in 1940 than for the past several seasons. *Ophiobolus yzinus*, a leaf sheath disease present in Arkansas and Louisiana, was und on rice at the station this year. It has not been observed on rice commercial fields in Texas. Straighthead occurred in some areas but most cases it was not particularly severe.

Leaf spot surveys of the rice growing areas near Katy, Eagle Lake, ay City, Angleton, Rosharen, and Beaumont, Texas, were made in ugust and September. In August the most severe *Helminthosporium yzae* leaf spotting of rice was observed in the Bay City-Angleton sec-on, and the most severe *Cercospora oryzae* spotting was in the Beaumont ea. In September there was no appreciable change in the amount of lminthosporium leaf spot observed but there was a marked increase in e amount of Cercospora spotting in the Bay City and Eagle Lake ctions. Some plants showing rotten neck were observed in the Beau-ont section but in no case was the infection severe.

On the station the Cercospora leaf spot was less severe on plants from edings made June 10 than on plants from seedings made March 20. here was little difference in the amount of Helminthosporium leaf spot rice from the two dates of seeding.

E. C. Tullis, B. P. I.

Black kernel disease: The ability of a number of commonly employed ngicides to prevent the production of black kernels in Fortuna rice was termined. The plants were dusted with the fungicides just prior to e emergence of the heads. On emergence of the heads and all during e flowering stage one half of each plat was inoculated with a spore sus-ension of *Curvularia lunata*, the causal agent of black kernel. The ants were allowed to remain in shocks in the field for one month after ing harvested. The shocks were wet with water daily in order to pply the moist conditions necessary for the development of black grains. o black kernels were produced in the controls or any of the treatments. owever, about 5% of the grains were discolored or pecky. The num-r of discolored grains was higher in the series inoculated with Curvularia an in the check series, but the plants dusted with the fungicides produced ore discolored grains than did the controls. Since no true black kernels ere found in the control plats no recommendations can be made for con-olling black kernel with fungicides.

C. E. Minarik.

Cylinder experiments on the straighthead disease of rice: Incorporation straw into the soil and high applications of nitrogenous fertilizers are garded as causes of straighthead in rice. In these experiments half the cylinders received rice straw at the rate of 3 tons per acre. Nitro-

gen was applied as sodium nitrate, ammonium sulfate and a combination o the two at the rate of 88 pounds and 176 pounds of nitrogen per acre The recommended amount of nitrogen for rice is 30 pounds per acre. Th effect of the straw was to decrease the yield of grain although no straight head symptoms were produced. In the straw series plants receiving al of their nitrogen from sodium nitrate yielded the least grain, while thos receiving ammonium sulfate produced the highest yields. In the serie without straw neither the amount nor the source of nitrogen affecte the final results. Straighthead was also absent from this series.

Straighthead studies in the field: Early Prolific and Blue Rose ric were grown in plats which had been fertilized with 1000 and 500 pound per acre of sodium nitrate and ammonium sulfate. During the earl stages of growth the plants receiving ammonium nitrogen were mor vigorous and possessed a darker green color than those receiving nitrat nitrogen. Plants receiving the higher rate of fertilizer attained the greates height. Yield data from the Early Prolific series are not reliable sinc there was a good deal of hurricane injury to this variety. Plants re ceiving 1000 pounds per acre of fertilizer were damaged more severel than the others. In the Blue Rose series the grain yields ran in the follow ing decreasing order: 1000 pounds ammonium sulfate, 500 pounds of am monium sulfate, 1000 pounds of sodium nitrate, 500 pounds of sodiu nitrate and check. None of the treatments produced straighthead.

White tip disease of rice: Early Prolific rice was grown in gravel cul ture in the greenhouse. Nutrient solutions containing all possible com binations of six different concentrations of magnesium and calcium wer applied to the surface of the gravel by the continuous solution renewa method of Shive and Stahl. When the heads were in the boot the numbe of plants exhibiting white tip were counted. An analysis of the dat shows that regardless of the magnesium content of the solution the num ber of plants with white tip decreased with increasing concentrations o calcium. However, 250 ppm. of calcium with low concentrations of mag nesium (5 ppm. and lower) produced calcium toxicity symptoms. De creasing amounts of magnesium in the solution were not accompanie by a reduction in the number of plants with white tip.

When Blue Rose and Early Prolific rice were grown in solution cultur with low calcium concentrations and with varying magnesium concentra tions, the severity of white tip increased with increasing concentration of magnesium. This experiment and the one preceding indicate that lo calcium and high magnesium are conducive to white tip formation. How ever, other evidence shows that improper magnesium-calcium ratio may not be the only cause of the white tip disease.

Sulfur applications: Activated and regular soil sulfur were applied a the rate of one-half ton and one ton per acre. The soil pH before appli cation of the sulfur was between 7.5 and 8 which is generally regarde as above the optimum for rice. Rexoro rice was grown. The grain yield

n in the following descending order: 1000 pounds activated sulfur, check, n regular sulfur, ton activated sulfur. The decreased yields from plats ceiving the heavier applications of sulfur are undoubtedly due to the ct that the sulfur was not completely oxidized before the fields were oded and that the remaining sulfur was reduced to hydrogen sulfide hich is known to have an injurious effect on rice. Where smaller appli- tions of sulfur were made the yields were better than those of checks, esumably because of the lower pH. Sulfur may be used on rice soils to wer the pH but if it is applied early in the spring before planting only ght applications should be made. Heavier applications may be made the soil is to remain idle for about a year before planting.

Cylinder experiments with acidified irrigation water: Early Prolific ce was grown in cylinders and irrigated with water adjusted to a defi- te pH with sulfuric acid. The pH ranged from pH 7 to pH 4. The st grain yield was obtained at pH 6.5 and poorest at pH 4.0. The acid- cation of irrigation water is not advisable unless it is excessively kaline or is being applied to alkaline soils.

Hydrogen sulfide on growth of Rice: Blue Rose plants were grown in lution culture and 10 ml. of hydrogen sulfide were bubbled through the ltures daily. The hydrogen sulfide uroduced stunted plants which died e month after treatment was started. The symptoms of hydrogen sul- le toxicity are stunted root and shoot growth and rolling up of the aves in a manner similar to that obtained under drought conditions. here was no chlorosis, the plants maintaining their green color through- t the experiment.

Aeration and Source of Nitrogen: Early Prolific rice was grown in so- tion culture in the greenhouse. The continuous solution renewal method Shive and Stahl was employed. Half of the cultures were aerated by bbling a stream of air through them. The nitrogen content of the solu- on was 10 ppm. and it was supplied as ammonium sulfate, sodium nitrate d a combination of the two. The plants receiving aeration produced a eater yield of grain, roots and straw than the non-aerated plants, in- cating that aeration is essential for the maximum growth of rice plants solution culture. The average total dry weight per culture was greatest here both ammonium and nitrate nitrogen were supplied, and lowest here ammonium nitrogen was the only source of nitrogen. The poor eld in the ammonium series is in direct disagreement with similar field udies and the explanation lies in the pH of the nutrient solution. Although e pH of the solution supplied to the ammonium series was adjusted pH 7.2 the plants quickly lowered it to 3.6. The initial pH of the nitrate lution and combination were 4.2 and 6.85 respectively. The final pH as 7.4 and 6.4 respectively. The final high pH of the nitrate series and e final low pH of the ammonium series were the controlling factors the results obtained in this experiment rather than the type of nitrogen *r se.*

Vitamin B_1 in the nutrition of rice: Early Prolific rice was grown in sand culture in the greenhouse. Nutrient solution was supplied by the continuous solution renewal method of Shive and Stahl. Vitamin B_1 was supplied as synthetic thiamin hydrochloride at the rate of 0.01 ppm. This concentration was increased to 0.1 ppm. after two months. The presence of vitamin B_1 in the nutrient solution had no effect on the final yield of straw or grain of these plants. Apparently rice is another plant which synthesizes sufficient vitamin B_1 to satisfy its needs and, when growing under ideal conditions, is not stimulated by applications of this substance to the medium in which the rice is growing.

C. E. Minarik.

Field Crop Investigations

Cotton Varieties: All but four of the twenty-three varieties produced more than 200 pounds of lint cotton per acre. Stoneville 2 B produced the largest yield of 473 pounds. The yields were slightly above normal, but would have been still larger if no damage had resulted from the storm on August 7 and 8.

Corn Variety and Hybrid Yield Test: Weather conditions were very favorable to this test up until the storm mentioned above. The test had to be harvested earlier than usual on account of all plants lodging as a result of the windstorm. However, the yields were above normal. Thirty-one varieties were grown, and the yields varied from 24.7 to 35.4 bushels per acre.

Castor Beans: Eight varieties of castor beans were tested the past year. Conner produced the largest yield of 439 pounds per acre, and Brazilian produced the smallest of 261 pounds. However, the yields of all varieties were injured by the storm during August. Practically all blooms and beans were blown from the plants, and many of the plants were killed.

R. H. Wyche.

Forage and Pasture Crop Investigations

Pasture Fertilization: Fertilizer treatments of nitrogen and phosphoric acid were applied separately and in combination, as well as in a complete fertilizer treatment, on both limed and unlimed soil. The use of nitrogen alone produced light increases in yield of forage. Phosphoric acid alone, or in combinations, resulted in increases up to 311 per cent. In general all treatments were more beneficial on the limed soil than on that not receiving lime.

Horticultural Crops Investigations

Citrus: All trees were severely injured by the low temperatures in January. However, no trees were entirely killed out.

Pears: The two trees of hybrid pear, T. S. No. 7493, continue to produce heavy yields of fruit. These trees showed a slight infestation of pear blight

he past year. This is the first time these trees have been infested with his disease.

Tung Oil: The tung oil trees produced a light yield of nuts. These rees continue to appear to be of very little value under the local soil onditions.

R. H. Wyche.

SUBSTATION NO. 5, TEMPLE

The Blackland Experiment Station, or Substation No. 5, is located two niles south of Temple and one-half mile west of the Temple-Taylor high- way No. 95. The latitude is 31° 3′ north, the longitude 97° 21′ west, nd the elevation 660 feet above sea level. The average annual rainfall ver a period of 28 years, 1913 to 1940, inclusive, is 34.78 inches, while or 1940 it was 41.02 inches. During the 28-year period an average of 6.64 nches of rain fell in the months of June, July, and August. The rainfall or these months in 1940 was 11.88 inches. The 28-year average rainfall or the six-months period, May to October, inclusive, is 17.75 inches, vhile 19.70 inches fell during these months in 1940. The 27-year average ength of growing season is 238 days, while the length of growing season or 1940 was 214 days.

The station consists of a total of approximately 547 acres of land. The oil on the station is typical of the Blackland region and is predominantly f the Houston and Austin series. All land is in cultivation except that oc- upied by farmsteads, roads, ditches, and natural drainage ways. There re approximately 34 acres of pasture along Boggy Creek, which is the ajor drainage way through the station.

The purpose of this station is to aid the development of the agriculture f the Blacklands, particularly through the solution of the major crop nd soil problems of the region. The soils of the region that have been ell preserved are very fertile and are admirably adapted to the growing f cotton, corn, grain sorghums, and small grain. The objectives of this tation are: the control of the cotton root-rot disease; the prevention of oil erosion; the improvement of soil fertility; the study of adaptable crop arieties; the study of various cropping systems; and the development of practical land use program. The cotton root-rot problem is being studied y the station under the supervision of the Division of Agronomy and the ivision of Plant Pathology and Physiology of the Texas Agricultural xperiment Station and in cooperation with the Bureau of Plant Industry f the United States Department of Agriculture. The Work Projects Ad- inistration is also cooperating with the station in the study of root-rot, nder Project No. 13622. The soil and water conservation problem of the rea is being studied by the Soil Conservation Service, Division of Re- earch, of the United States Department of Agriculture, in cooperation ith the station. During the last four years livestock projects to supple- ent cotton farming have been instituted.

Cotton Root Rot Investigations

(In cooperation with Bureau of Plant Industry, U. S. D. A., and with Work Projects Administration)

Sclerotial Studies. Records are made from time to time on the decrease or increase in number and viability of Phymatotrichum sclerotia in plots where various crop and soil treatments are located. Sampling for cotton root rot sclerotia was continued in 1940 and the depth of soil sampled was increased from the three-foot depth to a depth of eight feet in some cases. Samples were taken at the rate of 320 per acre with a six-inch posthole auger. In fields planted to continuous cotton, corn, sorghum, or oats, the greater part of the sclerotia were found in the upper thirty inches, but some were found at the greatest depth of sixty inches. Although somewhat fewer sclerotia (8086 sclerotia per sample) were found in the continuous cotton plots than in the continuous corn (8880 sclerotia) and sorghum (11,064 sclerotia) plots, those from continuous cotton land had a considerably higher viability. Again, soil samples for sclerotial analysis were taken to the six-foot depth on an area which has been in continuous cotton since 1928 and the greater part of the sclerotia were found at depths between 6 and 24 inches with a few as deep as six feet. In this case, fairly large numbers of sclerotia showing a good viability were found. Also, samples were taken from a native meadow under observation in past years and in which root-rot susceptible weeds were growing. Here, the greater part of the sclerotia were found between 6 and 42 inches; with a few at all depths including the last six-inch interval (90 to 96 in.). A fair number (2555) of sclerotia were found and these showed high viability. It is quite evident, therefore, that non-cultivated land may harbor large numbers of root-rot sclerotia. In another area that had been clean fallowed for about 11 years, all samples were taken to a depth of eight feet and analyzed in six-inch depth intervals. In this area 7932 sclerotia per sample and with high viability were found. They were most abundant in the 42 to 48 inch depth and about 90 per cent occurred at depths of 12 to 48 inches.

General Root Rot Studies

Effect of Rate of Planting Cotton Seed on Cotton Root Rot: A much lower percentage of cotton killed by root rot has been obtained in the cotton seed treatment tests where two seed per hill were planted than where five and ten seed per hill were planted. Five seed per hill resulted in smaller amounts of root rot than did ten seed per hill plantings. In the early season the thin planted plots had only about half as much root rot as the thick planted plots. The differences decreased toward the end of the season, but there was still considerably less root rot in the thin planted plots than in the thick planted plots.

Residual Effect of Different Soil Treatments on Root Rot in Cotton, Rose, and Privet: Cotton, rose and Amur privet were again planted on

plots that were excavated to a depth of three feet and copper sulfate, iron sulfate, crude oil, and formalin added to the soil as it was replaced in the pits for 1939 plantings. No artificial inoculations were made and there was little or no root rot infection on any of the plots in 1940 regardless of treatment. Copper sulfate at three ounces per cubic foot caused some yellowing and stunting of privet.

Soil Treatments for Cotton Root Rot and Chlorosis Control of Rose: A more detailed experiment was initiated in 1940 to determine the effect of various disinfectants and soil treatments on cotton root rot and chlorosis control of rose. Cupric sulfate, ferrous sulfate, ammonium sulfate, and soil sulfurs were used alone and in combination at varying rates. A combination treatment of two ounces each, per cubic foot of soil, of cupric sulfate, ferrous sulfate, and soil sulfur gave best results. No plants were killed by the root rot fungus and an average of 414 blooms were harvested per plot of nine plants which had a comparatively good color with a good growth throughout the season.

Relative Humidity as Affecting Death Rate of Cotton Plants with Root Rot: Two small glass frames, each 3 x 4 feet and 4½ feet high were constructed and equipped with humidifying equipment so that they could be set down over cotton plants in the field. Plants kept above a relative humidity of 80 per cent remained green at the end of experimental periods of approximately five weeks, while controls kept at natural atmospheric humidity (from 30 to 80 per cent) all died within three weeks after inoculation. It has been noted in fields that fewer plants succumbed to root rot during periods of intermittent showers, although the temperature and soil moisture conditions are ideal for rapid spread of the disease. Transpiration rates are comparatively low during such periods and the demands on roots, whether they be partially rotted or not, is, no doubt, comparatively low.

Residual Effect of Crude Oil, Crank Case Drainings, and Cotton Bur Ashes on Germination of Cotton Seed, Root Rot, and Yield of Cotton: Cotton was planted for the third time on plots that were treated with crude oil and crank case drainings at rates of from 2000 to 15,000 gallons per acre and with cotton bur ashes at rates from 2000 to 15,000 pounds per acre in November, 1937. There was still some toxicity to seed and seedlings at the highest rate of applications of both oils; however, both oils and the cotton bur ashes at the higher rates of application continued to give reductions in root rot. Plots treated with the highest rates of cotton bur ashes gave large increases in yields of cotton. The highest yield of 784 pounds of seed cotton per acre was obtained where 8000 pounds of cotton bur ashes was applied per acre in 1937, as compared to 574 pounds seed cotton from the no-treatment plots.

Residual Effect of Applications of Crude Oil at Different Depths on Germination of Cotton Seed, Cotton Root Rot, and Yield of Cotton: Cotton planted for the second successive year on land that was tilled at depths

of 5, 12, and 18 inches, followed immediately by applications of 1000, 2000, 4000, and 8000 gallons of oil per acre in January, 1939, showed that there was no toxic residual effect on germination where the oil was applied throughout the soil to a depth of 18 inches. Toxicity to seed and seedlings increased where oil was applied at 12 and 5 inch depths in the soil. Cotton root rot infection was reduced in all oil applications, the highest rates of application giving the largest decreases in root rot. There was about one-fourth as much root rot for all depths of application of 8000 gallons of oil per acre as in the accompanying checks. All applications of oil at the 12 and 18 inch depths gave increases in yield over the accompanying checks.

Application of Copper Sulfate and Crude Oil in Combination with Deep Tillage as Affecting Root Rot in Cotton: Copper sulfate in solution at 100 and 500 pounds per acre and crude oil at 250 and 500 gallons per acre were applied in field plots to a depth of 18 inches by means of equipment attached to a Killefer subsoil plow. Little or no root rot appeared in the entire experiment due to the fact that planting was delayed until the latter part of May. Delayed planting was caused by an abnormal period of dry weather following the tillage and application of chemicals. Residual effects of the treatments will be obtained next year.

Germination of Seed and Yield of Cotton from Seed from Plants Killed by Root Rot at Different Dates in 1939: Seed harvested from plants killed by cotton root rot at semi-monthly intervals beginning July 15 and ending September 15 in 1939 were planted in 1940 to obtain germination and yield records. Germination increased from a low of 12.8 per cent for seed from plants killed July 15 to a high of 71.2 per cent for seed from plants killed on September 15. Seed from plants killed July 15 gave a seed cotton yield of 205 pounds per acre, whereas seed from plants killed on September 15 produced 800 pounds of seed cotton per acre. Seed from plants killed on August 15 gave the highest yield of 878 pounds of seed cotton per acre. Results for a number of years show that as the date of kill is delayed, seed from such plants give increased germination and increased yield.

Analysis of Cottonseed from Cotton Varieties Grown in 1939 Having Different Dates of Maturity and Different Boll and Lint Characteristics: Since there was a possibility of some variation in oil and protein content of cotton seed from different varieties, analyses of seed from thirteen varieties having wide variations in dates of maturity, boll size, length of lint, per cent lint, and yield were begun in 1938. Analyses of seed from such varieties grown in 1939 were similar to those previously made in that variations in these morphological characters of the cotton plant apparently had little to do with the oil and protein content of seed. Oil varied from a low of 17.38 per cent for Qualla cotton to a high of 20.84 per cent for Mebane 804-50. Protein content varied from a low of 21.69 per cent for Roldo Rowden to a high of 24.69 per cent for Lone Star (Gorham).

Comparative Root Rot Resistance and Yield of Different Varieties of Cowpeas: Cotton root rot and chlorosis constitute the main diseases

affecting cowpeas when grown in the Blackland region. Selections for root rot resistance have been made from Brabham and Iron varieties which have shown more resistance to root rot and an almost total resistance to chlorosis in past years. These selections were planted along with fourteen commercial varieties in the 1940 test. Chinese Red variety had the lowest root rot infection of 11 per cent followed by Brabham with 13.1 per cent. Cream and Conch (Cream) had the highest root rot infections with 34.1 and 28.2 per cent respectively. Brabham selection had an exceptionally high yield of 17,000 pounds of green forage (top less seed) and 3,934 pounds of dry forage per acre. Iron was second highest in forage yield, followed by the Iron selection. Clay made the highest seed yield of 1428 pounds per acre, followed by Iron with 1,241 pounds of seed per acre.

Fertilizers in Rotation and Continuous Cotton as Affecting Root Rot and Crop Yields: In 1938 a fertilizer-rotation test was started in cooperation with the Bureau of Plant Industry, United States Department of Agriculture, to determine the effect of various commercial fertilizers and barnyard manure on crop yields and root rot in a four-year rotation of cotton-oats-corn-grain sorghum, in continuous cotton fertilized once in four years, and in continuous cotton fertilized every year. Since 1940 was the second year of this treatment, only cotton and oats have received the benefit of fertilizer in the rotation. Manure, at ten tons per acre, was the only fertilizing material that gave consistent increases in cotton yield. None of the treatments reduced root rot consistently. No significant increases in grain were recorded for any of the treatments. Cotton increases were not enough to compensate for the treatments.

Other Disease Studies

Fertilizer and Barnyard Manure as Affecting Prevalence of Angular Leaf Spot on Rotated and Continuous Cotton: Angular leaf spot infection counts were obtained on seedlings and on leaves and bolls of grown plants in the cooperative fertilizer-rotation plots on Substation No. 5 and on similar plots of the Bureau of Plant Industry, United States Department of Agriculture, near Travis in Falls County. Although there have been reports that fertilizers to some extent control angular leaf spot, this was not found to be the case in these experiments in 1940. Infection in all plots was around 80 per cent. Leaf infection in both experiments in all treatments was around 50 per cent; and boll infection varied from about 12 to 17 per cent.

Relative Susceptibility of Sea Island and Upland Varieties of Cotton to Angular Leaf Spot: Varieties of Sea Island cotton are generally more susceptible to angular leaf spot infection than the Upland varieties. F_1 seed from a Rowden x Sea Island cross were planted in plots along with Lone Star and Rogers Acala 111 to compare their relative susceptibility. There was a seedling infection of 4.1 per cent on the Rowden x Sea Island;

none on the Lone Star; and 0.8 per cent on the Rogers Acala. At the time of the first open boll, there was a boll infection of 10 per cent on the Rowden x Sea Island; none on the Lone Star; and 2.4 per cent on the Rogers Acala.

Spraying and Dusting with Sulfur for Angular Leaf Spot Control: Wettable sulfur used as a spray and 320-mesh dusting sulfur were applied three times during the 1940 growing season in attempts to control angular leaf spot infection on leaves and bolls. There was little or no reduction in infection, but small yield increases were recorded. The sulfur spray plots yielded 258 pounds; the sulfur dusted plots, 232 pounds; and the check plots yielded 226 pounds lint cotton per acre.

Cotton Seed Treatments: Cotton seed treatments in 1940 included the Cooperative Regional Tests B, C, C-2, and one wherein different rates of organic mercury dusts were used on fuzzy seed and acid delinted seed. The C Test was the main test and corresponded with tests made in previous years. Fifteen different treatments were used in this experiment which included nine organic mercury dusts, delinting with sulfuric acid, three combinations of delinting plus mercury dusts, and two copper dusts, together with the untreated checks. Seed were planted at the rates of two, five, and ten seed per hill in an early planting on April 1 and at the rates of two and ten seed per hill in a medium late planting on April 30. Copper componds were much less effective than mercury compounds or delinting with sulfuric acid. All treatments, with the exception of yellow copper oxide, increased germination from 5 to 45 per cent and all treatments reduced seedling infection about 3 to 20 times. Delinting with sulfuric acid and delinting plus additional treatment with mercury dusts in general gave best results. Sanoseed No. 1 was much superior to Sanoseed or Sanoseed No. 2. In general there was less root rot in the lower rates of planting; the differences, however, were not quite so striking as in the 1939 tests.

In the Regional B Test, machine delinted seed were compared with fuzzy seed. A lot of each treated with 1½ ounces of 5 per cent Ceresan were included. Machine delinting plus treatment with 5 per cent Ceresan gave highest increases in germination and yield. This treatment was followed in order by fuzzy treated seed, delinted untreated seed, and fuzzy untreated seed. A soreshin count made in these tests showed that approximately 75 per cent of the untreated seed were infected with soreshin organisms whereas only about 20 per cent of the treated had soreshin. D. & P. L. 11A, Stoneville, and Rogers Acala 111 varieties were used in this test. The D. & P. L. 11A and Stoneville had a much higher soreshin infection than the western grown Acala seedlings had.

The C-2 Test included the testing of a number of new materials on a somewhat smaller scale than was used in the main C Test. Twelve different treatments on seeds of two different varieties were used. U. S. Rubber No. 98 Protectant gave highest germination of 71.1 per cent for D. & P. L.

11A variety, and calomel treatment had the highest germination of 71.0 per cent for Stoneville variety. Copper-lime dust treated seed had the lowest germination of 48.3 per cent for the Stoneville variety, which was 5 per cent below germination in the untreated check, and red copper oxide treated seed had the lowest germination of 57.0 per cent (7 per cent above check) for the D. & P. L. 11A variety. Cyanamid mercurial, calomel, U. S. Rubber No. 120, and red copper oxide plus iodine were most effective in reducing seedling infection. All treatments gave fairly large increases in yield for the Stoneville variety, but not for the D. & P. L. 11A variety.

To test the most effective rate for certain of the organic mercury compounds, 5 per cent Ceresan was used at ½ ounce, 1 ounce, and 1½ ounces per bushel, and Ceresan and Sanoseed at the rates of 1½ ounces and 3 ounces per bushel. One ounce of 5 per cent Ceresan was more effective in increasing germination and yield than was ½ ounce or 1½ ounces of dust per bushel of seed. Three ounces of 2 per cent Ceresan and 2 per cent Sanoseed gave better germination and yields than did 1½ ounces of dust per bushel of seed.

Indole butyric acid was used at rates of 1000, 2000, and 5000 parts per million as a dust treatment on fuzzy seed, in combination with 2 per cent Sanoseed, 2 per cent Ceresan, and talc, and in 16-hour soaking treatments of acid delinted seed at rates of 2 milligrams and 6 milligrams per 100 cubic centimeters of water. Seed thus treated were planted in field soil in the greenhouse and in small nursery plots to obtain germination counts. In general, the seed treated with Ceresan and Sanoseed containing 1000 and 2000 parts per million of the Indole-butyric acid gave somewhat better results. The highest germination of 86.7 per cent was recorded where seed were treated with 2 per cent Ceresan containing 2000 parts per million of the acid.

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Seed Treatment of Oats: New Improved Ceresan (5 per cent) at the rate of ½ ounce per bushel, Sanoseed at the rate of 1½ ounces per bushel, formalin, one pint to 10 gallons of water used as a sprinkle, and formalin, one pint in one pint of water used as a spray, at the rate of these amounts of formalin solutions for 50 bushels of oats, all eliminated smut infection and increased yields of oats from 15 to 20 per cent in 1940.

C. H. Rogers.

Soil and Water Conservation Investigations

(In cooperation with the Soil Conservation Service, U.S.D.A.)

Soil and water conservation investigations at the Blackland Experiment Station have been in progress since 1929. This work is applicable to the Blackland region of Texas and to parts of the Grand Prairie.

Strip Cropping Investigations: Strip cropping systems of various designs are laid out on four plots approximately 5/100 acre in size, on six

plots 1½ acre in size, and on large field areas. During 1940, on small plots, where the contoured rows did not break, strip cropping was satisfactory. The 1½ acre plots, which are 432 feet long and 151 feet wide, and have slopes ranging from 2 to 3 per cent were started in 1939. The total rainfall for that year was 24.46 inches or 29 per cent below normal. In 1940, however, the total rainfall was 41.08 inches or 18 per cent above normal, and in three of the last six years, the annual rainfall has been 40 inches or more. In the latter part of October, November, and December, numerous rainstorms occurred which saturated the soil and gave large amounts of run-off and soil loss, even though the intensity was not great, the maximum being only 2.72 inches per hour for a 15-minute period. For these three months the total rainfall in 1940 was approximately 100 per cent above normal. When these rains started, the oats in the oat strips of the strip cropping system were very young and had formed little protective cover. On the 1½ acre plots, a three-year rotation of cotton, corn, and oats is used in 36-foot strips with oats as the resistant strip in a strip-cropping system. The rows are parallel to contour lines run at 108-foot intervals, and regular field tillage is practiced. On all of the 1½ acre plots and field areas some gullying occured. The amount of gullying increased with the increase in the degree of the land slope on which the strip cropping was located. The amount of washing was recorded by survey after each rain for all areas. Measurements of soil and water losses were taken for the 1½ acre plots but computations have not been completed.

Terraces With and Without Strip Cropping: This study was begun in the fall of 1939. During 1940, all of the terraces performed satisfactorily. There was no overtopping and very little silting of the channel in the terraces without strip cropping and practically no soil deposited in the channels of strip cropped terraces where the resistant strip of oats occurred immediately above the terrace channel. The soil loss for the terraces with strip cropping was slightly less than from the terraces without strip cropping. Quantitative data are not yet available from this study.

Protection of Eroded Land by Re-Vegetation—Grasses: Of the commercially available grass seed tried out at this station, Toowoomba Canary grass *(Phalaris tuberosa)* continues to be the most promising. A number of species which have done well on good land have been seeded on severely eroded land in Field C. On this area, successful seedings have been made of Buffalo grass, Blue grama, Switch grass, Silver beard grass, Western ryegrass, Little bluestem, Big bluestem, and Sporobolus asper. Further seedings are in progress.

Soil Movement Across Terraces: Soil movement lines across terraces have indicated that there is no down hill movement of the terrace ridges with respect to each other. In October, 1938, on Terrace C-7 a board border was installed on the terrace ridge. For the last two years, the relationship of the losses between Terrace C-7 and Terrace C-5 and C-6 has not changed to that of previous record. This absence of change in the relation-

ship of the soil losses indicates that there is very little soil movement up and over the terrace ridges and down the slope due to terrace maintenance or farming operations.

Infiltration Studies: Studies in progress using a rainfall simulator to study the relative effect of Bermuda grass sod, native meadow sod, and Buffalo sod, indicate that these covers differ very little in their run-off and erosion characteristics under saturated conditions. Run-off as high as 90 per cent can be expected from storms occurring when the ground is saturated.

H. O. Hill.

Agronomic Studies

In the general crop and soil experiments conducted on the station an attempt is made to furnish not only the basic information upon which the cotton root rot and soil and water conservation investigations are predicated but also to supplement these specialized studies in such a way as to complete a well-balanced research program on soils and crops for the Blackland region. The work specifically treated in this section is only that part of the field work for which a progress report is justified at this time.

Cotton Variety Test: A variety test of cotton has been conducted at this station since 1928. Of the 36 varieties grown in 1940, the highest yielding varieties in order of production are: Hurley Special, 289 pounds lint cotton per acre; Bryant Mebane 4-A-39, 286 pounds; Buckellew Mebane, 282 pounds; Mebane 804-50, 279 pounds; and Watson 276 pounds lint cotton per acre. Due to extensive root rot infection and angular leaf spot damage, yields in 1940 were considerably lower in the entire test than usual. Only nine varieties had a yield of over 250 pounds lint cotton per acre; sixteen varieties averaged between 200 and 250 pounds; seven varieties produced between 150 and 200 pounds; and four varieties yielded less than 150 pounds lint cotton per acre.

In a survey of the yields of the cotton varieties over the past ten-year period of the test, eleven varieties which have been grown each year are taken as the standards, and an average of their yields for the entire period is taken as a basis on which comparable yields for all other varieties have been computed. The average acre yield of the standard varieties for the ten-year period is 285 pounds lint cotton, and the averages of the leading varieties grown for as much as three years, in ranking order as to yield on a comparable basis, are as follows: Buckellew Mebane, 336 pounds; Watson, 325 pounds; Rogers Acala 111, 321 pounds; New Boykin, 307 pounds; and Ferguson 406, 304 pounds lint cotton per acre.

Varieties with staple length averaging 1-1/16 inches or more are: New Mexico College strain of Acala, Hunt-Tex. Shafter Acala, Cluster Durango x Wacona, Delpress No. 3, Greer Wichita, Lankart x Wacona, and Lone Star 26. Boll size averages for the period of years ranged from as high

as 7.30 grams per boll for Lankart x Wacona variety to as low as 3.89 grams for Okraleaf Acala.

Corn Variety and Hybrid Test: A corn variety test has been conducted at this station since 1928. In 1940 this test included a large number of commercial and experimental hybrids as well as the commercial open-pollinated varieties which are usually grown. The commercial hybrids were obtained from various seed firms in the Corn-Belt, and were tested because of the increased interest which has been shown by farmers in the Blackland region concerning the adaptability of this northern hybrid seed corn to Texas conditions. A large number of the experimental hybrids were the result of crossing Corn-Belt single crosses with Texas inbreds. These were tested to determine whether satisfactory hybrids for Texas conditions could be produced by using a combination of Corn-Belt inbreds and Texas inbreds. The remainder of the experimental hybrids were of purely Texas origin, being produced from some of the more promising inbred lines which have been developed by the Texas Station.

The 1940 crop season was very favorable for corn production, and yields in general were well above the average. The commercial varieties in the test this year, as a group, averaged 47.4 bushels per acre, and the commercial hybrids 56.4 bushels per acre, the commercial hybrids yielding an average of 9 bushels, or 19.4 per cent, more than the commercial varieties. The experimental hybrids grown in the test this year gave very promising results. The group of hybrids produced from Corn-Belt single crosses and Texas inbreds and the group of hybrids from purely Texas inbreds both gave substantial increases over the commercial varieties, as well as slight increases over the commercial hybrids. The group of Corn-Belt-Texas Station hybrids yielded an average of 57.5 bushels per acre, which was an increase of 10.1 bushels or 21 per cent over the commercial varieties. The group of Texas hybrids, with a yield of 60.1 bushels, averaged higher than any group of hybrids or varieties and also showed high resistance to earworms and weevils. In the 1940 test plantings were made at two rates for each variety or strain: the normal or 36-inch spacing rate and the thick or 18-inch spacing rate. The thick planting rate was much more productive than the regular rate; yields for commercial varieties were increased 23.1 per cent by the thick planting; for the commercial hybrids, 42.8 per cent; for the Corn-Belt-Texas hybrids, 38.8 per cent; and for the Texas hybrids yields were increased 30.7 per cent by the thick planting.

Five commercial varieties that have been grown for the last ten years of the test are used as standards on which comparable yields for all other commercial varieties are based. Considering those varieties that have been grown over a period of several years, Nelson's Native Yellow, Reese Drouth Resister, and Surcropper appear the best commercial varieties adapted to this region.

Sorghum Variety Test: The sorghum variety test has been conducted on this station since 1928. This year the test consisted of fifteen varieties.

The leading varieties with respect to grain yield in 1940 are as follows: Hegari, 61.2 bushels per acre; Chiltex x Hegari, 53.2 bushels; and Darso No. 28, 47.3 bushels threshed grain per acre. Yields of dry forage, although not extremely high, were good, ranging from 4.75 tons per acre for Leoti to 2.30 tons per acre for Hegari x Milo.

Two varieties of sorghum which have been grown every year of the test, Darso and Chiltex, are used as the standard varieties, the average of these two for the period of years being used as the basis for computing the comparable yields for all other varieties. For the nine-year period of the test, 1932 to 1940, inclusive, the average of the standards was 29.8 bushels threshed grain per acre and 3.21 tons dry forage per acre. On the basis of comparable yields, Quadroon has led in yield of grain with 35.9 bushels per acre, followed by Chiltex x Hegari with 35.0 bushels, and Double Dwarf Texas milo and Darso No. 28 with yields of 34.4 bushels each. Some of the newer varieties indicating their adaptability to growth in this area are: Quadroon, Double Dwarf Texas milo, Kalo, and Chiltex x Hegari. Darso No. 28 is also a good grain sorghum for the Blackland area because of its resistance to milo blight disease.

Sorghum Strain Tests: In order to test the adaptability of certain selections or strains of different varieties of sorghum to this region, two special strain tests are under observation. The Hegari strain test, planted for the second successive year, consists of five selections of Hegari with three replications of each strain on three planting dates. All Hegari selections gave excellent production for the first planting date on April 2, with the Woodward strain leading. Stover yields for the second date of planting were good, but grain was destroyed by infestation of the sorghum midge. The third planting, made on July 30, was killed by frost before any of the plants matured. The Schrock kafir strain test consisted of eight selections of that variety, planted in duplicate. All selections were unusually productive with high yields for both forage and grain. Selection 1B made the highest yields of 55.6 bushels threshed grain and 6.02 tons dry forage per acre.

Double Cropping Test of Early Sorghums: The double cropping experiment of sorghum, using Quadroon and Sooner milo in a comparative test of various methods of harvesting and second crop production, was for the purpose of determining the feasibility of growing two crops of grain from early varieties which have favorable characteristics of side-branching and tillering habits. This test was planted on two different dates. The early or April 2 planting was very productive of both grain and forage. The extremely dry weather following the first cutting of this test was unfavorable for the growth of a second crop. In both 1939 and 1940 no side-branching or tillering occurred in either the Quadroon or Sooner milo after the first harvest, and the stalks remaining in the fields withered and died. This test will not be continued further.

Small Grain Rust Resistance Test: A test for rust resistance, productivity, and general adaptability in varieties and strains of small grain was

conducted for the fifth year at this station in 1940. Oats, wheat, and barley were included. This year was not favorable for small grain production because of the lack of subsoil moisture at planting time and the general drouth which continued until late spring.

Leading varieties of oats in this test for 1940 were: New Nortex, 39.0 bushels; Nortex, 36.0 bushels; Nortex x Victoria M19-46, 35.4 bushels; Kanota x Victoria 13-33-70, 35.3 bushels; and Nortex x Berger M5-3, 34.4 bushels threshed grain per acre. A small amount of smut appeared on a few varieties, but no rust was observed. For the five-year period of the test, the most productive oats strains grown for at least three years had the following averages: Nortex x Victoria M19-53, 57.4 bushels; Red Rustproof (Ga. Sel. 281), 57.0 bushels; Nortex x Victoria M19-1, 56.6 bushels.

Yields from the 44 varieties of wheat in 1940 ranged from 21.0 bushels threshed grain per acre for Selection 41-224 to as low as 13.4 bushels per acre for Selection 41-27-3-2. Only three selections yielded more than 20 bushels per acre this year, these being 41-224 with 21.0 bushels, 41-206 with 20.2 bushels, and Clarkan with 20.0 bushels. Infections of stem rust and smut were very light this year, with only traces of infection being reported for a few strains. Of the varieties grown for as much as three years, wheat Selection 41-121 was the leading variety with a period of years average of 27.0 bushels threshed grain per acre. This was followed by Selection 41-16-3-3 with 25.0 bushels; Selection 41-22-1 with 24.2 bushels; and Selection 41-26-1-1 with 23.6 bushels per acre. These yields are compared to the checks of Selection 41-Bulk which averaged 21.3 bushels and Denton which averaged 20.2 bushels threshed grain per acre.

The eleven barley varieties gave fairly good yields of both grain and straw. All varieties showed a trace of leaf stripe, and Missouri Early Beardless had a trace of loose smut; no rust appeared in the test. The leading barley varieties in order of yield are: Tennessee Winter 15826, 23.2 bushels; Tennessee Winter 15825, 20.6 bushels; Harlan Hybrid 1-33-7, smooth awn, 20.4 bushels; and Wintex, 19.4 bushels threshed grain per acre. For the three-year period of the test, Harlan Hybrid 1-32-103, rough awn, has made the highest average yield of 30.5 bushels threshed grain per acre, followed by Harlan Hybrid 1-33-7, smooth awn, with 28.1 bushels.

Oats Winter Hardiness Test: A winter hardiness test of oats was conducted at this station in cooperation with the Bureau of Plant Industry, United States Department of Agriculture, Washington, D. C. Thirty strains were tested with germination percentages ranging from 88 per cent for Fulwin variety to 53 per cent for Victoria x Fulgrain, C. I. No. 3692. A minimum temperature of 5 degrees for the winter and the late freeze in April did some damage in this test, but the highest loss was

only 16 per cent winter kill for Victoria x Fulgrain, C. I. No. 3692, and for Nortex x Victoria, C. I. 3526. Thirteen varieties showed 100 per cent spring survival.

Flax Variety Test: In the fall of 1939 a flax variety test was inaugurated at this station with a planting of eleven varieties. Germination, though somewhat delayed, was good. All varieties were completely winter killed by 5 degrees temperature in January. In the spring of 1940 another planting of flax was made for the purpose of testing variety adaptability for spring and summer growth. Of the 44 varieties tested, Natural Hybrid 161 led in production with 10.0 bushels grain per acre, followed by Turkey, C. I. No. 860 with 9.9 bushels.

Small Grain Date of Planting Test: A small grain date of planting test has been conducted at this station since 1938 for the purpose of determining the optimum period for planting wheat in central Texas to secure the best yields. Kubanka strain of Durum wheat is used for this study. The January 1 planting averaged 9.1 bushels in 1940; the November 1 planting averaged 6.0 bushels; and the late or February 1 planting produced 5.9 bushels threshed grain per acre. The three-year averages for the three dates of planting are as follows: November 1, 15.5 bushels; January 1, 14.8 bushels; and February 1, 7.7 bushels.

Sweet Clover Winter Hardiness Test: The sweet clover winter hardiness test, conducted for two years, includes Hubam clover, a standard variety, and Melana clover, a dwarf variety introduced to Texas from Canada. This test was made for the dual purpose of determining comparative seed production and winter hardiness. Plants of both varieties were considerably damaged by the 5 degree minimum winter temperature. In general the plants of Melana clover seemed far more resistant to the cold, but the average seed yield for 1940 for four plats of this variety was only 85.8 pounds per acre compared to a single plat yield of Hubam of 579.2 pounds.

Castor Bean Variety Test: Eight varieties of castor beans have been grown in a variety test at this station for two years. In 1940 all varieties were seriously damaged by root rot infections with resultant seed shattering. The highest yield of 982.9 pounds threshed seed per acre was produced by Flowering variety, while Common made the lowest yield of 75.6 pounds per acre. The two-year averages indicate that Flowering, with 1278.0 pounds, and U. S. D. A. No. 7, with 931.4 pounds threshed seed per acre, are the most productive varieties.

H. O. Hill.

Comparison of Treated and Untreated Legumes for Green Manure: In 1940 a comparative test of treated and untreated legumes was planted for the purpose of securing yield and root rot data on Iron and Blackeye

cowpeas and Sesbania, for use as green manure crops. In every case the Nitragin treated seed yielded more forage than the untreated seed of the same variety. Treated Iron cowpeas yielded the greatest amount of dry forage with a production of 1.41 tons dry forage per acre. Root rot percentages for the treated plats were slightly higher than for the untreated plats. There was a root rot kill of 25.6 per cent in the untreated Iron cowpeas and 27.9 per cent in the treated; 73.5 per cent in the untreated Blackeye cowpeas and 80 per cent in the treated; 5.6 per cent in the untreated Sesbania and 5.9 per cent in the treated Sesbania. Root rot infection in the Blackeye variety was approximately three times as high as in the Iron. The Iron cowpeas are selections made over a period of four years at the substation from plants showing more resistance to cotton root rot.

C. H. Rogers.

Cropping Systems

The rotation studies at this station were designed for the double purpose of increasing yields and diminishing root rot. In 1940, fourteen different rotations were studied at this station as follows: two three-year rotations; three two-year rotations; four three-year rotations with green manure, two of which are planted on regular plots and two of which are on contoured areas; and five two-year rotations with green manure crops. The rotations without green manure crops have been under study since 1928; the green manuring rotations on contour were started in 1938, while all other rotations including green manure crops were started in 1939.

Cotton in Rotations: Cotton appears in all rotations under study. The highest cotton yield for 1940 was produced on a two-year rotation of cotton-oats with sorghum for green manure, which yielded 240 pounds lint cotton per acre; the two-year rotation of cotton-oats with cowpeas for green manure also had a higher yield than most of the rotations. All rotations exceeded the permanent checks in cotton production this year.

In the period of years' survey for 1928 to 1940, inclusive, the results of the rotations as to cotton production show the rotation of cotton-corn ranking first with an average of 276 pounds lint cotton per acre. This was followd by the rotation of cotton-sorghum-oats with an average yield of 265 pounds. None of the other rotations practiced for the full 13-year period increased yields over the continuous checks, which averaged 220 pounds lint cotton per acre.

The most promising rotations of the seven that have been in practice for only two years and which include green manure crops are those consisting of cotton-oats with sorghum for green manure and cotton-oats with cowpeas for green manure, with two-year average yields of 232 and 219 pounds lint respectively, compared to a two-year average of the

checks of 140 pounds lint per acre. From the present record it would appear that for a rotation to be effective in increasing yields of cotton in the Blacklands, it should include a green manuring crop.

Corn in Rotations: Corn was grown in nine rotations in 1940. The largest corn yield from rotations this year was 50.6 bushels shelled corn per acre from a rotation of cotton-corn-oats with sorghum for green manure. However, due to the exceptionally good corn season, all rotations and permanent check areas gave excellent yields, with little appreciable difference in the production of any of the areas.

Only two of the rotations including corn now under study have been in practice for longer than three years. Of these two, the rotation of cotton-corn has a thirteen-year average of 35.8 bushels shelled corn per acre, compared to 30.2 bushels for the rotation of cotton-corn-oats and 30.3 bushels for the permanent check areas.

Sorghum in Rotation: Sorghum was grown in 1940 in a three-year rotation of cotton-sorghum-oats and a two-year rotation of cotton-sorghum. Yields of both grain and forage in the two rotations were considerably better than the sorghum yields on the permanent checks. The three-year rotation produced 49.8 bushels threshed grain and 4.46 tons dry forage per acre; the two-year rotation yielded 48.0 bushels threshed grain and 4.56 tons dry forage per acre; and the permanent checks averaged 38.6 bushels threshed grain and 3.48 tons dry forage per acre. For the period of years, 1928 to 1940, inclusive, the three-year rotation averaged 35.0 bushels threshed brain and 3.46 tons dry forage per acre, compared to 30.4 bushels grain and 2.96 tons forage for the two-year rotation and also compared to the permanent check averages of 25.1 bushels threshed grain and 2.89 tons dry forage per acre.

Oats in Rotation: Oats appeared as a regular rotation crop in nine rotations in 1940. Yield of oats was very low this season due to lack of subsoil moisture during the fall and winter months. The highest yield of oats in the rotation studies was 30.7 bushels threshed grain per acre for the two-year rotation of cotton-oats with cowpeas for green manure. All rotations exceeded the yield of the permanent checks by five bushels or more. The rotations including green manure crops were all more productive than the rotations without such green manure crops.

Oats has appeared in three rotations for a thirteen-year period, 1928-1940, inclusive. Of these, the rotation of cotton-oats has the highest period of years average of 39.6 bushels threshed grain per acre, which is comparable to the permanent check average of 36.6 bushels. However, the most productive of the rotations tested are those started in 1939 to include green manure crops, the highest average oats yield of all being 48.2 bushels for the rotation of cotton-oats with cowpeas for green manure.

Green Manure Crops in Rotations: In 1940 green manure crops were included in nine different rotations for the second year. Four of these

rotations included winter-growing crops for green manuring, oats, barley, and mustard, and five included summer catch crops of sorghum and cowpeas for green manuring.

Of the winter crops, barley gave the highest yield of green forage with an average of 2.07 tons green forage turned under. Oats yielded 1.35 tons green forage, while mustard was killed out completely by freezes in January. Of the summer green manure crops, the highest green forage yield of 12.72 tons per acre was obtained from sorghum in the two-year rotation of cotton-oats with sorghum for green manure. The maximum production of cowpeas was 3.14 tons per acre of green forage.

H. O. Hill.

Root Rot in Rotations: With one exception, a two-year rotation of cotton-oats, there was less root rot in all rotations in 1940 than in continuous cotton areas used as checks. There was a root rot kill of 74.9 per cent in the continuous cotton plots used as checks against most of the two- and three-year rotations. Root rot in these rotations varied from a low of 27.6 per cent for a three-year rotation of cotton-corn-oats to a high of 76.4 per cent for the two-year rotation of cotton-oats. A three-year rotation of cotton-corn-oats with cowpeas as a summer catch crop and green manure had an end-season root rot kill of 24.3 per cent, compared to 41.4 per cent for the continuous check plot, while the same rotation with sorghum as a green manure and summer catch crop had a root rot kill of 37.8 per cent, compared to 64.6 per cent for the continuous cotton used as a check. These two rotations are on a larger scale than any of the other rotations on the farm and are planted on contour in longer rows.

C. H. Rogers.

Plant Introductions

No new introductions were made through the Bureau of Plant Industry, United States Department of Agriculture, in 1940. Of the 74 species introduced in 1937, 1938, and 1939, the following have proved most adaptable: *Clerodendrum* sp., *Cudrania tricuspidata*, *Fraxinus griffithii*, *Ilex* spp., *Pyracantha* spp., *Eucalyptus* spp., *Gleditsia sinensis*, *Sageretia theezans*, *Pterocarya stenoptera*, and almost all bamboos.

C. H. Rogers.

Observations of Plant Diseases and Insects

Miscellaneous Plant Diseases: Those field crop diseases giving most trouble, besides cotton root rot in cotton, during the 1940 season were: angular leaf spot, soreshin, and seed rots of cotton; cotton root rot of cowpeas, sweet clover, and castor beans; corn smut; and smuts and rusts of small grains. The smuts and rusts of small grains were comparatively light due apparently to the low rainfall in mid and late spring. Cotton root rot was rather prevalent in ornamentals. Photinia, Abelia, and Jas-

minium were found in certain locations dying from root rot. Chinese elm, firethorn, and cottonwood planted along some of the highways suffered heavily from root rot. The usual fairly high amount of root rot was found in plantings of Ligustrum, Euonymus, and a few other ornamental and vegetable crops. Other important diseases in 1940 were: limb canker on hackkberry; mildews on coralberry, crape myrtle, rose, lilac, and zinnia; tar spot on liveoak; black spot and cane blight of rose; and chlorosis of rose, spirea, ligustrums, crape myrtle, arborvitae, and a few other ornamentals and vegetable crops.

C. H. Rogers.

Insect Pests: Thrips in the early season and boll weevil in the late season were unusually severe in most cotton fields of the central Texas area. There was a higher earlier infestation of boll weevil in the eastern part of the central Texas area than in the western part due to the higher rainfall in mid-season. Sorghum midge and corn ear worm infestations were unusually high. Bagworms on arborvitae, hackberry, and junipers caused exceptionally heavy defoliation. Heavy damage was also observed due to pecan case bearers and lice on peaches, plums, cotton, pecan, arborvitae, and a number of ornamental and vegetable crops. There was the usual amount of infestations from ants, termites, white grubs, obscure scale on pecan, San Jose scale on peaches, and borers in pecans and peaches.

C. H. Rogers.

Livestock Investigations

With the recent movement toward soil conservation, improvement of soil fertility, and better land use, livestock studies go hand in hand with the new era in agriculture, and this fact is the basis for the adoption of a well-balanced livestock program for the future farming interests of the South and Southwest. The economic utilization of livestock for the Blackland region of of the state has been made an integral part of the practical land use and well-rounded agricultural program for this station. A tract of 34 acres along a creek on the station farm, formerly waste land, is being utilized as pasture for sheep and cattle.

Sheep: During 1938 a small flock of grade-Rambouillet ewes was purchased by the station for experiments in feeding and breeding. Since that time various crosses have been made with Romney and Dorset breeds in attempts to develop a type sheep that would have desirable characteristics for this section of the state. This breeding work is being done in cooperation with the Division of Range Animal Husbandry of the Texas Agricultural Experiment Station. Receipts from sale of lambs and wool in 1940 showed a good margin of profit over maintenance costs, allowing prices above market quotations on feed.

Cattle: On August 21, 1939, forty head of Hereford calves were purchased by the station. After two months on pasture, twenty head were put into the feed lot for an average feeding period of 124 days. The other

twenty head of calves were kept on pasture with small supplemental feed until September 14, 1940, at which time they were put in the feed lot for a period of 99 days. Allowing market prices for the station-grown feed and grain, this feeding project for the two groups of calves showed a good net profit.

Hogs: During September and October of 1939 a total of 108 head of pigs were added to the five remaining from previous feeding, making a total of 113 head of pigs to be fed out on the surplus corn, grain and miscellaneous feed grown on the station. Allowing market prices for feed, this project ended with an average loss of 61 cents per head.

Poultry: A flock of about 125 chickens was maintained on the station during 1940 for egg production and feeding tests. This project showed satisfactory returns. In November a special feeding project was started in cooperation with the Division of Poultry Husbandry of the Texas Agricultural Experiment Station; however, this project has not been in progress long enough for any data to be available.

H. O. Hill.

SUBSTATION NO. 6, DENTON

This station is located five and one-half miles northwest of Denton in Denton county. It is representative of the Grand Prairie Region of north central Texas, a region characterized by a rolling topography and dark heavy soils of the San Saba and Denton Series. This region is especially suitable for small grain production, although corn, cotton, and grain sorghums are important crops. The average annual rainfall for the period of 1913 to 1940 inclusive is 32.60 inches, of which 25.75 is estimated as the average annual rainfall effective for growing crops. The average length of growing season is 233 days with last killing frost March 25 and first killing frost November 13.

A large part of the work of this station is devoted to the breeding and improvement of small grains for the wheat, oat and barley growing regions of Texas. However, considerable time and effort are devoted to the growing and improvement of other field crops adapted to north Texas conditions and to experiments with pasture and soil improvement crops.

Small Grain Investigations

(In cooperation with the Bureau of Plant Industry, U. S. D. A.)

Growing conditions: Because of exceptionally dry weather in July August, September and October, 1939, plowing and other seedbed preparations were made very difficult. All fall plantings of wheat, oats and barley were made in dry, cloddy soil from October 15 to 20, and remained in this condition until November 12, when .63 inch precipitation provided moisture for full germination on well settled seedbeds but only partial germination on late prepared, loose seedbeds. This deficiency in moisture

was overcome by 1.36 inches rain on November 30, and good stands of all plantings were recorded by December 10. Weather conditions during December were very favorable for establishment of the grain crop before winter. Temperatures during the first three weeks of December were much above normal, but cold weather from December 24 to January 18 hardened all grain plants sufficiently to withstand the extremely low temperatures of 18 to 6 F. from January 18 to 28. Only the most tender oats varieties were partially or completely killed. Temperature and moisture conditions in February were very favorable for recovery of freeze damaged grains, and growing conditions continued favorable throughout March, April and May. Excessive rains late in May and throughout June greatly hindered the harvesting and threshing of small grains.

Leaf rust of wheat was extremely late in starting this season and did not gain sufficient headway to materially damage any of the varieties. Stem rust of wheat made its appearance on April 19, but did not spread rapidly because of cool weather. Only late maturing susceptible varieties were damaged. Neither crown rust nor stem rust were important factors in the production of oats this season.

Wheat

Experimental work with wheat at the Denton Substation consists of a varietal test of new versus adapted varieties; regional studies of varieties in field plats and in nursery tests; extensive nursery tests of varieties and newly developed strains; breeding nurseries where new strains are developed by hybridization and selection; regional and local studies of leaf rust, stem rust, bunt and loose smut; and studies of quality of wheat for flour and pastry purposes.

The field plat test consisted of 21 varieties of hard and soft winter wheat. Stem rust injured the late maturing susceptible varieties, reducing their yield and quality of grain. The quality of grain was further injured by wet weather after harvest. A new Kawvale x Tenmarq C. I. 1956 strain, developed at this station, led all varieties in yield this season. This new strain is resistant to loose smut, to leaf rust and has considerable resistance to stem rust. Preliminary tests indicate its baking quality is satisfactory. Tenmarq is the leading commercial variety of hard winter wheat in the tests over a period of years and has been distributed from this station for several years. Clarkan has given the best average yields of the soft winter wheat varieties. The new smut resistant Oro x Tenmarq strain continues to produce promising yields.

The advanced nursery consisted of 97 varieties and strains of hard and soft winter wheat planted in replicated nursery plats. Thirty strains were a part of the regional U. S. D. A. Uniform Yield Nursery. Most of the strains were hybrid strains grown for comparison with standard varieties. Very little leaf rust was present this year but stem rust injured some varieties and strains. For the most part, good quality grain was produced in spite of rather high rust infection. Among the more promising

strains in this nursery are the Denton selections of (Kanred x H. Fed. 142) x Tenmarq. Some of the promising new strains of this cross nearly doubled the yield of certain older varieties.

The preliminary nursery consisted of 166 strains of wheat, most of which were newly developed hybrid strains. Some very promising new strains were present in the test this year and many will go into advanced nurseries next season.

Breeding work to develop stem rust resistant soft wheats for this area continued with the growing of more than 3000 plant rows from the new stem rust crosses. Most of this hybrid material was in the fourth generation, and resistant selections were pulled individually for replanting in plant progeny rows.

Disease resistance studies of rust and smut were made with the growing of regional U. S. D. A. nurseries for this purpose. Many bunt resistant strains developed at the station were retested and considerable hybrid material was grown for selection of bunt resistant segregates. Studies of varietal resistance to loose smut were continued with the testing of nearly 200 strains.

Lodging and shattering inheritance studies were continued. Some very desirable second generation material was grown and studies of the Kanred x Coppei, and Kanred x Clarkan crosses. Varietal studies of resistance to lodging and shattering were continued.

A cooperative soft winter wheat variety test was continued at Greenville. Pastry studies of these wheats were not continued this season. Leading varieties in yield this season were Red May and Kawvale.

A spring wheat nursery of 22 varieties and strains was grown. Due to a very favorable spring season, some exceptional yields were obtained. Mindum durum wheat produces an average of 59.1 bushels per acre, while Ceres-D. C. x Ceres C. I. 11894, a common wheat, produced an average of 52.3 bushels per acre.

Oats

Oats investigations are carried on similar to the wheat tests. The development of disease resistant red oats is the principal objective. Oats are grown from both fall and spring seeding.

Eleven varieties were tested in field plats from both fall and spring seeding. Good yields of high quality grain were produced but all grain was damaged some in the shock. New Nortex, which has been distributed by this station for a number of years, continues to be one of the leading varieties. Fultex oats, a new smut and crown rust resistant variety developed at this station was distributed to farmers for the first time this season. It is especially adapted to combine harvesting.

Nursery tests of oats consisted of a comparison of 40 strains from both fall and spring seeding. Both tests encountered favorable growing conditions and were not injured by rust. High yields of good quality grain were produced. Although some yields superior to standard varieties were made by hybrid strains, the material now in these nurseries has been rather thoroughly tested and nothing new of great interest was noted.

Breeding work to bring stem rust resistance into the more promising varieties and strains is now making good progress. A considerable number of head row plantings were grown and several bulk hybrids were advanced another generation.

Disease resistance studies of oats consisted of regional uniform nurseries of rust, smut, and winter hardiness. Little rust developed this season in this test. Rather poor infection was obtained in the smut nursery.

A study of the varietal differences of lodging and breaking over following maturity in red oats was continued. A test of the shattering resistance of these varieties failed to show differences. This probably was due to poor adaptation of the wheat shattering machine to this purpose.

Barley

Barley investigations carried on are also similar to that of wheat and oats. A field plat variety test of eleven varieties was grown. Yields were good and quality was above average although the grain was damaged some by rains after harvest.

Wintex barley continues to be the leading variety in this section. A variety called Tenkow, obtained from the Oklahoma Experiment Station was the leader in yield this season.

Forty varieties and strains were tested in the replicated nursery tests. No new strains of unusual importance were noted this year. The desirable material in the nurseries has now been worked through and it is hoped to obtain some material from our new disease resistant hybrids soon.

Breeding work to bring rust and smut resistance into such desirable strains as Wintex and Harlan Hybrid 1-33-7 (smooth awn) is now making good progress. The second generation of crosses involving these parents is now harvested.

A winter hardiness nursery of barley was grown as in past seasons. This is a part of a regional study. Several new varieties developed at other Experiment Stations were taken from this nursery for testing next season.

Flax

Seven varieties of flax planted on each of three separate dates further confirmed the previous records of higher yields from earlier planting. The seven varieties planted on March 9 produced an average of 17.6

bushels, while when planted on April 2 they averaged 7.8 bushels. Th leading variety planted at the early date was North Dakota with a yiel of 21.8 bushels, while Rosquin led in yield with 11.9 bushels per acre a the late date.

Rye

Five varieties of rye were planted this season, and produced the highes yields ever made by rye at this station. The leading variety was Lubboc with a yield of 37.8 bushels per acre, while the lowest yield was produce by Common rye with 25.2 bushels per acre.

I. M. Atkins.

Corn Varieties and Hybrids

Growing conditions for corn were almost ideal this season. Plant growt was retarded slightly by excessive rains in May.

A total of 108 open pollinated commercial varieties, northern produce commercial hybrids, Texas produced Cornbelt-Texas hybrids and Texa double cross hybrids were planted four times each in the corn variet test this year. The Texas Station hybrids averaged 47.4 bushels per acre as compared with 44.7 bushels for Cornbelt-Texas hybrids, 39.1 bushel for Cornbelt commercial hybrids and 39.6 bushels for open pollinate commercial varieties.

The highest yielding Texas Station hybrid produced 53 bushels, whil the best Cornbelt-Texas hybrid made 50.7 bushels, and the highest com mercial open pollinated variety made 49.2 bushels. These results, as wel as those in 1939 when Texas hybrids as a group outyielded the commercia open pollinated varieties by 6.3 bushels per acre, or 22.4 per cent, defi nitely indicate that Texas hybrids are superior in yield to commercia open pollinated varieties.

The average yields of open pollinated commercial varieties over a perio of 10 years show that the white varieties, Surcropper, Reese Drouth Re sister, Multisure and Blankenmeyer White Dent, and the yellow varieties Denco Yellow Dent and Skiles' Yellow Dent, are the best adapted to thi region. This station produces pure state registered seed of Denco Yellow Dent and Yellow Surcropper for sale to farmers.

For the first time this year a small acreage was devoted to the pro duction of a high yielding double top cross hybrid for sale to Texa growers under the name of Texas Hybrid No. 4. A much larger acreag will be planted in 1941 on the assumption that the demand for Texa produced hybrid seed corn will increase greatly as growers become con vinced that the high cost of the seed is justified by the higher productio over ordinary open pollinated varieties.

Grain Sorghums

Variety Test: Twelve varieties of grain sorghum were replicated thre times each in the variety test this year. Seasonal conditions were almos

ideal and remarkable yields of both forage and grain were made. Hegari 1942, Chiltex x Hegari (SA79) and Hegari SA278 made 115.8, 107.2 and 104.7 bushels per acre respectively. The next highest yields were 99.6, 90.4 and 89.5 for Double Dwarf Milo, Hegari S. P. I. 61455 and Chiltex. Forage yields ranged from 5.29 tons dry forage for Early Hegari to 8.17 tons for Hegari SA278.

A new variety of sorghum called Cribbage Corn T. S. 26949 yielded 95.0 bushels of grain and 10.78 tons dry forage per acre. Atlas Sargo made 75.2 bushels of grain and 13.56 tons forage, and Red Top made 41.9 bushels of grain and 9.74 tons dry forage per acre. All three of these sorghums measured 8 feet tall at maturity.

Corn versus Grain Sorghums: This test was started in 1928 to determine the relative value and production of the commonly grown grain sorghum varieties as compared with the most productive variety of corn. During the period of 1932 to 1940 the average yield of grain in bushels per acre was 28.6 for corn, 43.8 for Chiltex, 39.4 for Darso, 32.9 for Ajax and 29.4 for Hegari. The low average yield of Hegari was due to the exceptionally low yield made in 1935 and to complete failure to make grain in the extremely dry year of 1936.

In forage production for the period 1932 to 1940, Hegari, Darso, Ajax and Chiltex made yields of 4.22, 4.09, 3.47 and 3.41 tons dry forage per acre, respectively.

Because of the slightly higher production of grain and the value of the forage produced by the grain sorghums, the livestock farmer in north Texas should make greater use of grain sorghums for feed. When properly handled in rotation with other summer crops, such as cotton, the grain sorghums are not "hard on the land."

Effect of Grain Sorghum and Corn upon Succeeding Crops: Since 1933 a study has been made of the influence of sorghum varieties and corn on the yield of oats, wheat, barley, corn, cotton and cowpeas. The entire stalk of corn and the stubble of the sorghum varieties are plowed under about September 1 and the above named crops planted at their normal dates. In general, the average yields indicate that the deleterious effect of the grain sorghums does not last longer than about June 1 of the following year. Apparently the duration of the effect depends upon soil moisture and temperature conditions and the activity of micro-organisms, which break down the sorghum residue in the soil. Fall planted wheat and barley and spring planted oats are reduced in yield from 10 to 15 per cent, whereas, corn is affected very little and cotton and cowpeas are not damaged at all. This experiment is important to farmers in that it is clearly shown that they need only to plow under their sorghum residue as early in the fall as possible and then follow with such late spring crops as cotton, sorghum, cowpeas, etc.

Effect of Different Amounts of Sorghum Stubble or Stalk on Yield of Oats: Quadroon and Texas Milo grown in 3-foot rows in 1939 were cut so that

stubble 8, 30 and 60 inches tall were left on the ground to be plowed under in November and followed by spring oats in February. In one series of 8 plats the stubble was not plowed under, and in another series of 8 plats all stubble was removed by hand before plowing. The yields of oats straw and grain were not significantly different following sorghum stubble removed and plowed and sorghum stubble 8 inches tall and plowed. The yields of oats straw and grain were not significantly different following sorghum stubble 30 inches and 60 inches tall and plowed, but were slightly lower than oats following stubble removed and stubble 8 inches tall. The highest yields of oats were made following 8 inch sorghum stubble left standing and no preparation other than levelling the beds with a spring tooth harrow. Since this is the first year for this experiment, the results are not conclusive and indicate only that fall or spring planted small grains would produce better following grain sorghum if the stubble was left standing and the seedbed for oats was prepared simply by scratching or harrowing.

Double Cropping with Early Grain Sorghums: The object of this experiment is to determine the amount of side-branching or tillering that may occur after early maturing sorghums are cut for either grain or forage. Quadroon and Sooner milo were planted at early and medium dates in plats that could be harvested by cutting the heads in the usual manner, cutting the heads at the upper node, cutting the heads to include the top 3 to 5 leaves, and by cutting the entire stalk and head as would be done with a row binder. Because of favorable moisture in July and August, sucker or tiller growth following harvest of the first crop was much bettter than average, but the suckers or tillers produced grain only from the early planting. Midge infestation became very heavy late in the season and blighted all heads of the first crop as well as the second crop in the late planting. The yields of grain from the sucker heads of the early planting were light and about the same from all methods of cutting the first growth, but considerably less than that from the 6 inch stubble which made a very creditable yield of grain. Since the yields of sucker or tiller growth were not considered worth while, even in this very seasonable year, this experiment will be abandoned with the conclusion that attempting to make two crops of grain or forage in a single season from tillering types of grain sorghum would not be practical.

Cotton

Variety test: Exceptionally favorable moisture and temperature conditions for cotton prevailed throughout the growing season, and yields of all varieties under test were exceptionally high. The average yields from 6 replications of each of the 36 varieties in the test this year show Bryant Mebane 4A-39 at the top with a yield of 555 pounds lint per acre. The next highest yields were 500, 499, 488, 486, 480 and 478 pounds lint per acre for Sunshine Selection 36-4, Roldo Rowden, Sunshine Selection 137-5, Hurley Special, Mebane 804-50 and Sunshine Selection 83-3 in the order named.

For the 10 year period, 1931 to 1940, the leading varieties are Watson, Cliett, Rogers Acala, and Ferguson 406 with comparable average yields of 293, 286, 282 and 280 pounds line per acre respectively.

Cotton Breeding: Twenty-three selections of Sunshine cotton T. S. 10104, which have been continuously inbred and selected since 1929, were planted again this year in the study of "The Effect of Inbreeding on the General Uniformity of Plant Characters." From this breeding work have come two exceptionally good strains, selections 74-2 and 83-3, both of which are in the lead in the regular variety test as well as in this breeding test over a period of 6 years. Both have been increased, and a small amount of seed is now available for distribution to farmers.

Legumes

Variety Test: A large number of varieties have been tested at this station but very few have proved adapted to general farm use in this area. For fall planting and use for pasture and soil improvement only the bur clovers, Black Medic and alfalfa have given satisfactory results. Hairy Vetch and Austrian Winter peas will withstand average winter freezes and are fairly satisfactory for hay or soil improvement; however these legumes make very slow growth during the winter, furnish very little pasture and ordinarily do not produce seed sufficient for harvest or to insure a good volunteer stand.

For spring planting the sweet clovers, particularly Madrid, a yellow blooming biennial, have proved superior to other legume varieties for hay, pasture and soil improvement. Hubam, the annual white variety, cannot be fall planted in this area and, when spring planted, does not yield as well as the biennial varieties. However, it matures earlier than the biennials and should be given preference on land infected with cotton root rot disease. Cowpeas are very satisfactory for soil improvement on land not infected with cotton root rot. The Brabham variety is fairly resistant to root rot. The Chinese Red variety is the most satisfactory for both seed and forage production.

Sweet Clover Method of Planting: Sweet clover planted in 36 inch rows alone or with spring oats as a nurse crop has been more satisfactory, particularly in dry years, than when planted broadcast or with a grain drill. Planting alone in 36 inch rows is recommended for thin, drouthy-natured soils and when grazing and soil improvement are mostly desired. When sweet clover is planted in spring oats by any method, the yield of oats is slightly reduced, and the sweet clover does not make sufficient growth following harvest of the oats to be cut for hay, but is valuable for late fall pasture or for turning under as green manure.

Soy Beans

Forage Production: The yields of forage were exceptionally good this season due to the very favorable moisture and temperature conditions in

June and July. Date of planting had very little effect upon forage production. The average yields of forage show O-too-tan, Avoyelles, Palmetto, Macoupin and Laredo leading with approximately 2 tons dry forage per acre each. Laredo is preferred for general farm use because it is less palatable to rabbits and produces high quality forage.

Seed Production: Because of exceptional growing conditions, a few varieties made creditable yields of seed this season. Twenty, 14.9, 11.2 and 8.0 bushels per acre were recorded for Manchu, Macoupin, Mamredo and Laredo in the order named. Seed yields in the regular variety test previous to 1940 have been very poor and, even in 1940, the high yield of 20.0 bushels could not be considered satisfactory for commercial production.

Soy Bean Nursery: A total of 317 varieties and strains of soy beans were planted in single rows 3 feet apart and 20 feet long for the primary purpose of finding a variety that might prove sufficiently productive for profitable seed production in this area. All varieties made good growth and at no time suffered from extreme heat or from lack of moisture which, no doubt, accounts for the fact that 136 varieties made seed ranging from 2 to 42.3 bushels per acre. Of this number, 40 varieties made 20 bushels or more per acre. Only the most promising of those making seed this year will be continued in the test another year. However, seed of a large number of varieties not yet tested will be planted in the 1941 nursery. It is believed that a variety should be non-shattering, heat and drouth resistant, lend itself to combine harvesting, have yellow seed of high oil content and average 20 bushels or more seed per acre to be worthy of commercial production in this area.

Crop Rotation Studies

Cotton Rotations: The influence of 10 different types of rotation on the production of cotton as compared with cotton grown continuously on the same land has been recorded each year since 1931. The average yields of cotton in the different rotations are not significantly different but indicate that rotations including small grains and other root rot resistant and soil binding crops facilitate farm operations, provide better weed control and tend to reduce losses from soil erosion and from certain plant diseases and insect pests. Rotation of cotton with corn and small grains is a common practice in this north Texas area, and the experiments thus far do not suggest a more profitable practice.

Corn Rotations: Corn also is grown in 10 different rotations in comparison with corn grown continuously on the same land. Production has not been greatly influenced by the type of rotation. Rotations in which sweet clover or cowpeas are planted as annual soil building crops have increased the yield of corn slightly. Other types of rotation have had little or no influence on the yield of corn.

Wheat Rotations: Rotating wheat with other small grains or corn has materially increased yields when compared with wheat grown con-

tinuously on the same land. Also, the use of sweet clover in the rotation has produced profitable increases in the yield of wheat.

Oats Rotations: The yield of oats has been significantly increased by rotation with corn or cotton and by the use of sweet clover for soil improvement. Planting sweet clover in oats has reduced the yield of oats slightly but this loss is converted into gain when the oats follow sweet clover plowed under two or three months ahead of planting.

Pasture Experiments

Grass Varieties: Twenty-four strains of Buffalo and 36 varieties and strains of grasses that might be of value in establishing meadows or permanent grass pastures were planted this year in small plats to study habits of growth, drouth resistance, seeding ability, forage production, etc. All but two of the Buffalo strains germinated satisfactorily, made good growth and produced some seed. It will take one more year of growth before these strains can be accurately rated for forage and seed production. Such tall grasses as Switch, Galleta, Indian, Windmill, the Side Oats Gramas and Big and Little Blue Stem appear to be adapted and have value for meadows or temporary pastures. Canadian Wild Rye appears promising as a winter and early spring pasture grass. All of the wheat grasses (species of Elymus and Agropyron) are more or less susceptible to heat and drouth and are not adapted in this area. Festuca elatior shows considerable drouth and cold resistance and may have value as a meadow grass. Angleton grass, St. Lucie and Carpet Grass do not survive average winter freezes in this area. Rescue and Italian Rye grass have given good results when planted alone on cultivated land or when planted in native grass pasture for late winter and early spring grazing.

Buffalo Seeding and Sodding Test: Buffalo grass seeded at the rate of 20 to 30 pounds per acre in rows on well prepared, listed beds 3 feet apart, from April 15 to May 15, and carefully cultivated to keep out tall growing grasses and weeds has produced almost solid turf in one season. Seeding narrower rows or by drilling has not been satisfactory because of difficulty in keeping down weed growth. Presoaking the seed from two to five days before planting increases and hastens germination. Present seed prices of $1.00 per pound are prohibitive. Seed may be harvested at reasonable expense by clipping established Buffalo grass at the proper time with a lawn mower and grass catcher.

Sodding Buffalo grass stolons or sod pieces in listed furrows, 3 feet and 6 feet apart, has proved a slow method of establishing the grass under field conditions because of the difficulty of keeping down weed competition. This method is very satisfactory in establishing a lawn where water may be applied immediately after sodding and close clipping with a lawn mower controls weed growth.

P. B. Dunkle.

SUBSTATION NO. 7, SPUR

Substation No. 7, Spur, is located one mile west of Spur, Dickens county, latitude 33 degrees north, longitude 100 degrees west, at an elevation of 2,274 feet above sea level. Spur is located on the Rolling Plains of Texas, being 14 miles east of the escarpment known as the Cap Rock, which forms the line of division between the High Plains and the Rolling Plains of West Texas. The average annual rainfall for 30 years is 20.55 inches with extremes of 11.09 inches and 38.08 inches. The average length of growing season is 215 days. The station comprises 579.5 acres, of which 380 acres are in cultivation and the remainder in native grass pastures. The soils consist of Abilene and Miles clay loams and are characteristic of a large portion of the soils of Northwest Texas.

The station is concerned with three principal lines of research: The development of profitable crop farming under conditions existing in the region; the utilization of feed crops grown in the section in the fattening of cattle and sheep; and complete conservation and utilization of rainfall, including storm water from rough areas, in the production of cultivated and native plants.

Seasonal conditions were highly unfavorable for crop production in 1940. The rainfall was 13.58 inches, or 6.96 inches below normal. At the optimum planting time the soil moisture on the greater part of the station was at or below the wilting point to a depth of 5 feet. Small showers that came later in the season were insufficient to provide the moisture needed to obtain good stands of crops. An acute moisture shortage prevailed throughout the growing period. If the ground had not been so very hot and dry the 1.79 inches of rain that fell August 13 to 17 would have been partially effective, but the moisture was quickly dissipated through the action of the sun and wind. During November 3.16 inches of rain fell, which is an all time high for November rainfall. This moisture will be of great value to small grain and will furnish some carry-over moisture for row crops in 1941.

Cotton Experiments

Varieties of Cotton: All cotton varieties produced low yields as a result of severe drought extending throughout the growing season. The yield of 25 varieties varied from 58 pounds for Western Prolific to 26 pounds for Harper, of lint cotton per acre. Over a period of years the Mebane strains and Half and Half have been the higher and more dependable yielding varieties.

Date of Planting Cotton: Plantings of cotton have been made at 10-day intervals from April 10 to July 10 during 23 crop seasons. The highest yield in 1940, 147 pounds of lint per acre, was produced by plantings made on June 1. The optimum date of planting has varied greatly with seasons but as an average of the long time period, plantings made at the middle

of May have given the highest yields, and crops have been produced more economically than from earlier plantings.

Spacing of Cotton: In this test the spacing between plants in 36-inch rows is increased by 3-inch intervals from 3 inches to 36 inches. The highest yield in 1940, 62 pounds of lint per acre, was produced by plants spaced 9 inches apart. During 20 crop seasons, the highest average yields have been produced by plants spaced 9 inches apart, however, the difference in yield from spacing of 9 to 27 inches is small. The cotton plants apparently are able to adjust themselves satisfactorily with any spacing within the range given.

Method of Planting Cotton: In 1940 rows 36 inches wide with plants spaced 9 inches apart and every third row left fallow produced 139 pounds of lint per acre, rows 36 inches wide with plants spaced 12 inches apart yielded 76 pounds of lint per acre, and 72-inch rows with 6-inch spacing produced 93 pounds of lint per acre. Over a period of 8 years, 72-inch rows with plants spaced 6 inches apart have given the highest average yield of 214 pounds, with paired 36-inch rows producing 199 pounds and regular 36-inch rows producing 194 pounds of lint per acre.

Grain Sorghum Experiments

Grain Sorghum Varieties: Eighteen varieties of grain sorghums were given yield trials in 1940. The highest yield, 19.4 bushels per acre, was made by Darso No. 28, Hegari being a close second. Texas milo produced 5.3 bushels per acre. The most dependable grain sorghums over a period of years have been dwarf yellow milo, Texas blackhul kafir and Spur feterita.

Date of Planting Milo: Plantings made on June 1 and June 10 made the highest yields in 1940, however, the difference in yields from plantings made on April 20 to July 1 were small. The highest average yields over a period of 23 years have been made by plantings in the latter part of May and the early part of June.

Spacing of Milo: The spacings ranging from 18 to 27 inches between plants in 36-inch rows gave the highest yields in 1940. The highest average yield over a period of years was obtained by plants spaced 21 inches apart. The optimum spacing varies from year to year with closer spacing being more desirable in wet years and wider spacing giving higher yields in dry years.

Method of Planting Milo: In this test the same number of plants are used for each method, although plantings are made in 36-inch rows, 72-inch rows and in paired 36-inch rows with every third row fallow. In 1940 the highest yield of milo was obtained by planting made in 36-inch rows. The difference in yields from any of the methods is very small. A practical procedure is to plant in 36-inch rows and then if soil moisture and stands justify, plow out every third row or every other row.

Soil and Water Conservation Studies

(In cooperation with Soil Conservation Service, U. S. D. A.)

The results of the experiments at this station are applicable particularly to the Southern Great Plains Area. This project has been under way for 15 years and has for its purpose a study of the factors influencing run-off losses and soil erosion and the effect of water and soil conservation practices on crop production. The factors contributing to run-off and soil losses are studied on control plats 1/75 acre in area. The efficiency of various terracing systems and other obstructions and of different crops in preventing water and soil losses is studied on field areas varying in size from 6 to 120 acres.

Rainfall: The average annual rainfall for the 15 years covered by soil and water conservation experiments is 19.69 inches, or .86 below the long time mean from 1911 to 1940, and 1.3* inches below the 15-year mean prior to 1926. The extremes of yearly rainfall are 38.08 inches in 1926 and 12.88 inches in 1934. The season of 1940 was characterized by frequent scattered showers with intervening periods of high temperatures and low humidity. Sixty-seven per cent of the 1940 rainfall occurred during the growing season as compared to 78 per cent for the 15-year period. A 2.35-inch rain on November 24 and 25 was heaviest of the year. This is the first time since weather records were begun at this station in 1911 that a rain period of over 2 inches occurred in November. All of the opportunities that occurred for water conservation during the year were with the rains of 1.31 inches on August 17 and 2.35 inches on November 24 and 25.

Torrential Rainfall: Although the total rainfall for 1940 was 6.96 inches below normal, the highest rate of run-off occurred since the studies were started in 1926. The amount of rainfall occurring as torrential (At rate of .75 inch per hour or more) was 19.59 per cent of the annual. Only 5 rains during the year were sufficiently torrential to produce run-off which matches the rainfall for 1934 in an all time low. The largest number of rains in any one year producing run-off was 17 in 1928. The average for 15 years is 9.53.

Water Lost Through Run-off: Water lost through run-off from the 13.58 inches of rainfall in 1940 varied from no run-off on areas with closed level terraces to 3.71 inches on a control plat that is fallowed and has a 2 per cent slope. Over a period of 15 years, there has been no run-off from areas with closed level terraces and the average annual run-off from fallowed land with a 2 per cent slope has been 5.45 inches. Over the same period of time and with the same slope, the average run-off from plats planted to cotton has been 3.07 inches, milo 2.23 inches and buffalo grass 1.07 inches.

Soil Losses Through Erosion: The soil losses from field areas with closed level terraces in 1940 was none and the average for 15 years was none. The average soil losses over a 15-year period from small plats

having a 2 per cent slope has been 1.17 tons per acre from grass, 3.36 tons per acre from milo, 6.40 tons per acre from cotton and 9.96 tons per acre from fallowed plats.

Syrup Pan Terrace System: Run-off water from a 1200 acre watershed above the station has been diverted during the past 10 years onto a 120 acre tract of cultivated land that has a system of level terraces with alternate ends partly open for conducting the water back and forth across the field as it flows toward the lower end of the field. In 1940, two rains caused water to flow on the tract. A rain of 1.31 inches on August 15 provided sufficient flow to flood the upper 56 acres while a rain of 2.35 inches on November 24 caused water to flood the entire 102 acres. The area which was flooded by the rain in August produced a fair crop of feed while that on the remainder of the tract which received no flood water for a period of two years was a failure. The flood water applied in November came too late to benefit the current year's crop, but should provide favorable moisture conditions for the next crop.

Over a period of 10 years, 22 rains have caused water to flow on the tract, all of which have supplied enough water to flood the upper 56 acres. Only 9 rains, however, have supplied enough water to flood the entire 102 acres. The water available for crop production has been increased 21.62 per cent on the upper 56 acres and 13.58 per cent on the lower 64 acres. In years with below normal rainfall, this additional amount of water has meant the difference between fair to excellent crops and crop failures. Damage to crops during heavy flows of water has been negligible and the cost of terrace maintenance has been many times repaid by increased crop yields. The success of this system of flood irrigation is reflected by the general use that farmers and ranchmen of the region are making of it.

Field Areas: Water and soil conservation practices as put into effect on areas of 6 to 10 acres in size show that crop yields have been substantially increased through the utilization of a larger portion of the rainfall. The soils of the region, in general, are sufficiently deep, porous and can absorb and hold within the root zone of most crops all of the water that falls during any crop season. To produce maximum crop yields and reduce the hazards of short crops and crop failures, it is essential to conserve preseasonal rainfall to supplement rainfall during the growing season.

The following data from field areas give the effectiveness of various water conservation practices employed on the station for reducing water losses.

Treatment	Inches of water lost as run-off	
	1940	Average 1927–1940
Terraces 3″ fall per 100 feet	.93	2.04
Rows with the slope	1.15	1.19
Level terraces, ends open	.38	.70
Rows on contour	.34	.57
Level terraces, ends closed	0	0

Level terraces with ends closed or partially closed have, within the last few years, come into general use throughout the region.

Contour Listing Native Grass Pastures: Recent trends in pasture improvement have been toward increasing the cover of palatable forage through the utilization of a larger portion of the rainfall. Contour listing has restored badly denuded pastures to a high state of productivity. The vegetation on the pastureland used in these experiments consists primarily of buffalo grass (Buchloe dactyloides) with trace amounts of other grasses. The yields in 1940 are low because of critical moisture conditions and severe decline in basal cover following the extreme drought of 1939.

The following table reports yields of air-dry grass per acre from land with 1 to 3 per cent slope on Miles gravel clay loam that was contour listed at intervals of 39 inches to a depth of 3 inches.

Treatment	Yield, lbs. air-dry vegetation per acre						
	1935	1936	1937	1938	1939	1940	Average
Unlisted	858	592	259	810	45	135	450
Contour listed 1934	2424	2315	1133	1376	425	500	1362
Contour listed 1936	.....	1326	2159	1973	448	554	1292
Contour listed 1938	.....	.....	.....	1178	707	652	846

In 1940, approximately four times as much grass was produced on listed as unlisted land. Attention is called to the highest relative yields being produced in the 2nd and 3rd years following listing. The question is frequently asked, "How often should grass land be listed?" These data and also the appearance of the grass on the several areas during the summer months emphasize the importance of this question.

Maximum penetration of moisture during the growing season in 1940 was limited to the surface 3 to 5 inches on the unlisted areas and to a depth of 15 inches on pastureland that was contour listed. Somewhat deeper penetration of moisture occurred on areas which received run-off. Over a period of 4 years the average available moisture during the growing season has been increased from 1.00 inch on unlisted land to 2.23 inches on pastureland listed in 1934.

Basal cover determinations in 1940 on quadruplicate meter plats show the effects of severe drought conditions in 1939 and 1940 on the cover of range plants. On unlisted pastureland the total percentage cover was reduced from 33.88 per cent in 1938 to 14.66 per cent in 1940 and from 75.76 per cent to 54.91 per cent on areas listed in 1934. Despite the decline in basal cover on all treatments, the cover on the listed land is approximately 4 times that on the unlisted pastureland.

Mesquite Eradication: Within the past 25 years the spread of Mesquite brush in flats and swales on the range and pastureland in the region has reduced the amount and quality of grass. It has also materially

handicapped the application of soil and water conservation practices. In 1940 studies were continued toward developing some simple and economical method of eradicating Mesquite on an area which was dense with a second growth wood "slick bark limbs and sprouts" and many seedlings.

Approximately 40 trees were treated at monthly intervals by removing the topwood at the soil line and painting the sapwood of the stumps with a specially prepared solution of sodium arsenite. Larger trees were girdled at the soil line and poison was placed in the groove. Other treatments consisted of removing the topwood and spraying the stumps with kerosene, a mixture of kerosene and gasoline, and a solution of sodium chlorate. Spraying the lower 6, 12, 18, and 24-inch portions of limbs and sprouts of trees was another method of treatment used. Additional materials including creosote products, crankcase oil, ammonium sulfamate, sulfamic acid, copper sulfate and zinc chloride were tried on a smaller scale.

On October 17, 1940, there were 88.3 per cent of the 351 trees treated with sodium arsenite in 1939 that had failed to resprout. The girdling method of application on larger trees gave complete control of sprouting.

Applications of kerosene, in most instances, killed the topwood but new growth occurred around the base of over 70 per cent of the trees a few months to a year after treatment. The use of sufficient kerosene to penetrate the soil to a depth of 8 to 10 inches around the taproot controlled sprouting. None of the other materials tried appeared to be as effective as sodium arsenite.

The sodium arsenite solution placed in the sapwood spread rapidly throughout the plant. Arsenic was found in roots 3 feet below ground and in limbs 7 feet above ground. Kerosene apparently kills plant tissue only at the point of application, which possibly explains the high percentage of resprouting unless heavy applications are made at the soil line.

Factors Influencing Germination of Buffalo Grass Seed: Millions of acres of cultivated land in the Southern Great Plains area would be returned to grassland if practical methods of reseeding were known. Studies were initiated in the spring of 1940 to determine factors such as depth of planting, surface litter, shade, seed treatment and soil moisture on germination and survival of Buffalo grass. A higher percentage of germination and survival resulted from plantings at a depth of ½ inch than at depths of 1 inch, 1½ inches or 2 inches, while negative results were obtained from shading. Sorghum litter applied at the rate of 1 ton per acre increased germination of seed and survival of seedlings, but applications of 5 tons per acre gave negative results. A higher percentage of germination and survival was obtained from seedings made on May 11 than from seedings made on August 7. Removing the husks and planting the caryopses did not increase germination.

Strip Listing Native Grassland: In a study to determine the value of conserving the run-off for the production of native vegetation, two areas

approximately 70 feet wide and 100 feet long, were solid listed to retain all the rainfall. On two closely adjoining areas of similar size only the lower half was listed so as to receive run-off from the untreated land. The average yields for 1938, 1939 and 1940 are shown in the following table:

Treatment	Yield, pounds of air-dry vegetation per acre		
	Upper half of area	Lower half of area	Average
Solid listed	924	1182	1053
Strip listed	440*	1410	925

*Untreated area.

Solid listing the entire area produced an average of 128 pounds more grass per acre than the strip-listed land, however, the grass on the area with only the lower half of the land listed remained green longer during the summer months and probably was of higher quality.

Relation of Sunlight to the Yield and Quality of Vegetation: It is desirable to know whether Mesquite and other brush, in addition to vying with grass for plant food and moisture, may affect the yield and chemical composition of grass through shading. A series of latticed cages which admitted different amounts of sunlight were placed in an open area of grassland and the yield and quality of forage determined. In 1940 the highest yield of grass, 932 pounds per acre, was produced under cages with lath spaced three inches apart, and the yield of grass produced in full sunlight was 273 pounds per acre. Over a period of 3 years, cages with lath spaced 3 inches apart produced the highest yield of vegetation. Chemical analysis of the grass harvested indicates that sugars and carbohydrates were materially reduced by heavy shading while the protein, crude fiber and phosphoric acid were slightly increased.

The Depth of Penetration of Rainfall as Influenced by Soil Types: It has been shown in experiments at the Spur Station that approximately 75 per cent of the rainfall is dispersed through evaporation. It is desirable to know more about the factors contributing to opportunities for evaporation and to develop practices that will reduce these opportunities.

A series of 16 lysimeters were installed on April 1, 1939, to measure the depth of penetration of rainfall as influenced by soil types. The soils used were Miles fine sandy loam, Miles clay loam, and barnyard manure secured from pens where cottonseed hulls were used as a roughage in cattle feeding.

In 1940 there were 2 rain periods that produced practically all of the percolate. These were on August 15-17 following 1.72 inches of rain and on November 24-25 following 2.35 inches of rain. The latter rain was the only one during the year that wet clay or sand to a depth of 12 inches. The amount of water passing through the 12-inch layer of clay soil was .06 inch as compared to .89 inch through sand and 1.76 inches through manure.

The rainfall during 1939-1940 was only 64 per cent of normal and the depth of penetration was possibly far below normal. Only 16 per cent of the rainfall reached a depth of 2 inches in clay soil, while 30 per cent and 45 per cent reached a depth of 2 inches in sand and manure respectively. During hot dry summer months all of the free water in the upper 2 inches of soil is extracted through the action of the sun and wind within 2 to 4 days.

Water, in order to be effectively stored in the soil, and out of the reach of the wind and sun, must be stored below a depth of 8 inches. Only 3 per cent of the rainfall reached this depth in the clay soils and 8 per cent in the sandy soils.

R. E. Dickson and C. E. Fisher.

Cattle Feeding Experiments

Vitamin A Requirements for Fattening Beef Cattle

(Cooperative with the Divisions of Range Animal Husbandry, Chemistry, Veterinary Science, and Bureau of Animal Industry, U. S. D. A.)

Previous work at Spur has shown that cattle may be fattened on carotene levels which are too low for the maintenance of normal health. The object of this experiment, which was the sixth of the series, was to study the effect of different quantities of carotene upon the gain and slaughter qualities of fattening beef heifers.

The experimental animals consisted of forty Hereford heifers which weighed an average of 364 pounds at the start of the test.

The heifers were divided into four groups of ten animals each and placed in individual pens after the first 28 days of the depletion period. One group of heifers was started on a level of 1000 micrograms of carotene per 100 pounds of live weight daily and was maintained on this level throughout the experiment. As soon as the animals of the other three groups were depleted, they were placed on levels of 800, 1000 and 1500 micrograms of carotene respectively.

The difference in the average gains for the groups was not significant, however, the heifers maintained on the 1000 microgram level from the start of the experiment made slightly higher gains.

Blood Carotene: An analysis of the blood carotene at the beginning and end of the depletion period, and at the end of the experiment was made of blood samples from heifers of each group. The calves had an average blood carotene content of .59 parts per million at the beginning of the experiment. By the end of the 98-day depletion period, the blood carotene of the heifers maintained on the 1000 microgram level from the start had dropped to .31 parts per million as compared with .16 parts per million for the heifers which had not received carotene during the depletion period.

The effect of the different levels of carotene upon the blood carotene during the 140-day fattening period is shown in the following table.

Changes in Blood Carotene During the 140-Day Fattening Period

Group No.	Carotene level in micrograms per 100 pounds live weight	Total blood carotene in parts per million		Gain or loss
		Beginning	End	
1	800	.16	.19	+.03
2	1000	.16	.21	+.05
3	1500	.16	.34	+.18
4	1000	.31	.27	−.04

Time Required for Restoration of Night Vision: A group of 20 steer calves averaging 225 pounds were depleted of their vitamin A reserves, as indicated by night blindness, in an average of 79 days. They were then turned on winter wheat pasture. Ten of the steers regained normal night vision in 18 days, and in 24 days only four were definitely night blind and three others were suspected. At the end of 42 days on green wheat pasture, all of the steers had regained normal night vision.

Length of Time Required for Depletion of Vitamin A in Range Cattle: During the five years of this study, 270 head of cattle have been used. It has been observed that the length of time required for depletion is determined by the body reserves of vitamin A which are affected by (1) the age of the animals and (2) the vitamin A potency of the forage on the range from which the animals come. Thus, during dry years when there are only limited amounts of green forage, the length of time required for deficiency symptoms to occur is less than during years of abundant rainfall when green vegetation is plentiful.

Following the favorable range year of 1935 a period of 178 days was required to deplete 16-month-old-steer yearlings until they became night blind, while in the dry year of 1939, only 56 days were required to deplete 5-month-old-steer calves to the same degree of night blindness.

In dry feed lots yearling cattle may be expected to show first symptoms of vitamin A deficiency in 90 to 125 days when fed cottonseed meal and cottonseed hulls with, or without, grain and in 125 to 175 days on sorghum roughages or silage when fed liberal amounts of concentrates. Calves fed similar feeds may be expected to become depleted of vitamin A reserves 25 to 50 days earlier than yearlings. A higher percentage of vitamin A deficiency cases has been observed in boys' club calves than in commercial feed lots. This is probably due to the fact that club calves are started at an earlier age on dry feeds. One pound of good quality alfalfa hay per head daily will supply the practical vitamin A needs of cattle in the dry feed lot.

R. E. Dickson, J. K. Riggs and P. T. Marion.

SUBSTATION NO. 8, LUBBOCK

Substation No. 8 is located 3 miles east of Lubbock, Lubbock county, which is on the southern tip of the south extension of the High Plains Region. Locally this region is known as the South Plains.

The latitude is 38 degrees and 37 minutes north, longitude 101 degrees and 45 minutes west, and elevation 3215 feet above sea level.

The average annual rainfall over a period of 30 years was 18.55 inches, with yearly extremes of 8.73 and 31.88 inches. The rainfall for 1940 amounted to 13.76 inches. The Station comprises 160 acres of land, 152 in cultivation and the remainder in farmstead and native pasture. The soil is of the Amarillo and Richfield fine sandy loam type, which is typical of a great portion of the region.

The predominant agricultural crops of this region are sorghums and cotton. The program of work at this Station centers around these two crops under both dry land and pump irrigation conditions.

Grain Sorghum Experiments

Grain Sorghum Varieties: The principal varieties of grain sorghums grown in this region are milo, kafir, and hegari, with an increasing interest in the combine types on account of the economies in harvesting.

Seasonal conditions were considerably below normal resulting in correspondingly low grain yields. Soil moisture was adequate until July. This month received no precipitation and with both high temperatures and evaporation, crops deteriorated rapidly, beginning toward the end of the month. Continued deterioration was experienced during August and September as precipitation continued deficient for each month.

Under the above conditions the average yield of 17 varieties was 7 bushels. Resistant Sooner milo led with 12 bushels, followed by Texas Milo (also pythium resistant) with 11.2 bushels. The kafirs as a group averaged 7.8 bushels, with little or no difference in yields between the various strains. Early Hegari yielded 8.5 bushels while Hegari made 3.6 bushels.

Pythium Resistant Strains of Milo: Efforts to isolate superior strains of dwarf yellow milo resistant to milo blight, Pythium arrhenomanes, were continued this year. Twelve of the more promising strains grown in 139 were compared with a non-resistant variety. The fact that they were grown on land cropped to cotton in 1939 and the lack of sufficient rain to give a normal response prevented an accurate reading.

On two different plats of land continuously cropped to milo the non-resistant strain yielded 9.6 and 7.1 bushels, the resistant 13.8 and 24.0 bushels per acre.

Distributions the past three years has resulted in practically all milo now being grown to be pythium resistant.

Hegari Strains: Five strains of Hegari grown at different latitudes in the sorghum region were planted at three different dates: May, June, and July to study their response to length of day and planting date as measured by various characters. Strains received from Arizona; Woodward, Oklahoma; and Chillicothe, Texas, showed no significant difference for all three dates. Early Hegari showed a distinct difference in its response in number of days to first bloom for all three dates. The acute shortage of moisture made it difficult to obtain definite information.

Sorghum Breeding

Combine Types: A number of promising kafir-milo hybrids were again selected in the nursery for field tests. A limited distribution made from two selections in 1939 which had appeared promising under field conditions the past two years were distributed.

Hegari-Milo: Two selections with yellow seed and extremely early in maturity will be grown in the strain test again in 1941.

Sumac-Kafir: Nursery selections for field testing were made which correspond closely to Dwarf Kafir in height and maturity but with sweet, juicy stalks.

Charcoal Disease, Sclerotium bataticola: This disease, which results in severe lodging of the plants at approximate milk stage of the grain, was not very severe this season. It appeared to be more prevalent on land continuously cropped to sorghums than on rotated land. None of the irrigated areas were affected this season, indicating that where the plant is kept in a healthy, growing condition, little damage is caused.

Cotton Experiments

Cotton Varieties: Thirty-six varieties of cotton were grown in 1940, ranging in staple length from 7/8 to 1-1/16 inch. The average yield of lint for all varieties was 154 pounds. The five highest with yields were:

Variety	Acre yield, lint pounds
Deltapine A	268
Watson	235
Stoneville 2B	233
Lentz Acala	228
Ferguson 406	223

Yield differences varied more than usual this year. Seasonal conditions were extremely poor. As practically all cotton is harvested by snapping rather than picking the tendency is to grow varieties of 7/8 to 15/16 inch staple, in preference to the longer lengths as the shorter length cottons make a better grade.

Cotton Breeding: The cotton improvement program at this Station has several objectives: to produce an unusually early maturing strain which can be used in years when late planting is necessary due to various causes; and a cotton suitable for mechanical harvesting. Fifty-seven crosses and backcrosses were made and selection work has continued several years. As the selections have been purified for various characters these cottons have been increased and harvested mechanically in cooperation with the Division of Agricultural Engineering. Eight out of ten selections from the above crosses produced a grade of middling cotton when harvested mechanically in 1940.

Pasture Grasses: Sudan grass seeded in rows was compared with Buffalo Grass (Buchloe dactyloides) turf under both dry land and irrigation. Five irrigations were given the Buffalo grass and six to the sudan. The Buffalo yielded four cuttings and the sudan eight cuttings. Yields of green hay, tons per acre, for Buffalo grass were 1.79 and .28 for irrigated and non irrigated. Air dry weights were 1.06 and .19 tons. Yields of sudan were 19.22 and 6.91 green weight, and 2.57 and 1.31 dry weight.

Date and Method of Preparing Seed Bed: The seed bed is prepared during January and April. Two methods and depths were used: plowing and listing, and 3.5 and 7 inches deep.

Results with Grain Sorghum: January prepared ground averaged 8.4 bushels per acre, as compared to 7.0 for April. Plowing averaged 6.0 bushels per acre, while listing averaged 9.3 bushels. Seven inch prepared seedbed averaged 7.6 bushels per acre as compared to 7.8 for 3.5 inches. Date or depth exerted little influence on production this season. Listing, however, was noticeably a much better method.

Results with Cotton: January prepared ground averaged 129 pounds of lint per acre as compared to 130 for April. Plowing averaged 126 pounds, listing 132. Seven inch prepared seed bed averaged 128; three and one-half inches, 130 pounds.

Soil Fertility and Moisture Conservation: Sixty-four 1/10 acre plats are devoted to a study to determine the effect of continuous cropping, fallow, fertilizing, with barnyard manure, green manure, and various crop rotations on both crop production and soil moisture. Cotton and grain sorghum are the crops grown, with sorgo used for green manure.

Results with Cotton: This year the average for the 21 plats was 220 pounds of lint per acre. The highest yield was obtained from a four year rotation of cotton after fallow after green manure after grain sorghum with 399 pounds of lint per acre; the lowest yield of 115 pounds was made from a 2 year rotation, cotton alternated with grain sorghum manured. Cotton continuously cropped for 26 years and barnyard manure applied at the rate of 4000 pounds per acre yielded 204 pounds; where unfertilized 194 pounds.

Results with Grain Sorghum: Twenty-one plats were cropped to grain sorghum. The three highest plats were as follows:

Grain sorghum after cotton and green manure	18.8 bu.
Grain sorghum after green manure after cotton	16.1
Grain sorghum after cotton manured after fallow	13.1

Where grain sorghums have been grown continuously for 26 years the yield was 1.6 bushels, as compared to 2.4 bushels where barnyard fertilizer at the rate of 4000 pounds per acre is applied.

Residual Effect from Barnyard Fertilizer and Cotton Burrs: Plats which had received an application of 2, 4, and 8 tons of barnyard manure and two tons of cotton burrs per acre for 5 consecutive years were compared with plats which had not received fertilizer. To study the residual effects, none of the plats were fertilized this year. Poor moisture conditions existed throughout the growing season. Acre yields of lint cotton of 168, 176, 158, 146, 140 pounds were obtained from the plats where no fertilizer, 2, 4, 8 tons of barnyard fertilizer, and 2 tons of cotton burrs had been used in the past.

Pump Irrigation Studies

Cotton and Grain Sorghum under Pump Irrigation: An experiment to determine the time and total amount of irrigation water necessary to produce adequate yields and its date of application was started in 1936. As set up, the experiment calls for the following treatments: no irrigation, one preplanting irrigation, two preplanting irrigations—one preplanting and post planting irrigation, and one preplanting and two post planting irrigations. All irrigations are applied at the rate of three acre inches of water. The post planting irrigations are applied, as nearly as possible at the most effective time.

Results with Cotton: Plats receiving no water outside of rainfall averaged 114 pounds of lint cotton per acre as compared to 226 for the one preplanting watering, 356 where two preplanting irrigations were made, 381 with one each of preplanting and post planting, 472 with one preplanting and two post planting. The two plats receiving summer irrigations, because of lateness in maturing, produced 4 and 12 per cent respectively of low grade cotton.

Results with Grain Sorghum: Dwarf Yellow Milo received the same treatment as above; the yields in order were: 4.3, 22.4, 37.1, 45.1, and 50.6 bushels per acre.

Fertilization of Cotton Under Irrigation: Plats receiving an application of 8 tons of barnyard manure per acre in 1939 were unfertilized in 1940. The average yield of lint in 1940 was 887 pounds of lint per acre. Nonfertilized plats averaged 678 pounds of lint per acre.

Alfalfa: All plats receive two irrigations per cutting. Irrigating just previous to cutting was slightly better than irrigating just after cutting.

Seedbed Chiseling: Land that was chiseled fourteen inches in depth and received irrigation water yielded 458 lint pounds of cotton per acre as compared to 454 pounds per acre where no chiseling was practiced.

Sugar Beet Production: Curly top was extremely severe. The April 16 planting was considerably better than the May 15.

For seed, 1240 pounds of seed per acre was produced.

Corn Varieties: Corn production this season was a practical failure. The best hybrid variety equaled the best open pollinated. Seasonal conditions were such that no definite conclusions could be attempted.

D. L. Jones and Frank Gaines.

SUBSTATION NO. 9, BALMORHEA

This Station is located adjacent to the Old Spanish Trail Highway. The elevation is approximately 3200 feet above sea level. The latitude is 31 degrees north, and the longitude is 103 degrees and 41 minutes west. The annual precipitation is very variable with an average of 14.24 inches for the past 18 years. However, the annual amount has ranged from a minimum of 3.89 inches in 1934 to a maximum of 28.15 inches in 1932. Because of this limited rainfall it is not possible to produce crops profitably without the addition of irrigation or flood water from some source. During the summer growing season the humidity is low and evaporation is high and for that reason unusually large amounts of irrigation water are required to produce crops. Most of the water used in irrigating the Balmorhea area comes from continuously flowing springs, but this supply is supplemented by flood water from the Davis Mountains which is caught and stored in a reservoir known as Lake Balmorhea. This area is served by the Pecos Valley R. R., a branch of the T. & P. R. R. and is also well supplied with paved highways in all directions.

Because of the variable climatic conditions, this area is not well suited to most specialized crops and work on the Station has dealt largely with the problems connected with the development of a better balanced type of agriculture. This has included the growing of many varieties of the principal staple crops, cotton, alfalfa, and sorghums, and the utilization of these crops in the fattening of cattle and lambs.

Fattening Cattle in the Madera Valley

Cattle feeding experiments in 1940 included a comparison of hegari fodder and Red Top fodder as the principal roughage when fed with 2 pounds per head per day of 43% protein cottonseed meal and 3 pounds per head per day of ground alfalfa hay. In this test grain consisted of ground milo heads. Under these conditions ground hegari fodder produced slightly more gain than Red Top fodder.

Lamb Feeding Tests

In February 1940 five lots of 50 lambs each were finished after an 84 day feeding period. This test included a comparison of alfalfa hay and alfalfa molasses silage, in which the hay was slightly superior to the silage from the standpoint of gains made. However, the alfalfa silage kept in excellent condition and was greatly relished by these lambs. Lots 1, 2, and 3 received ground hegari as the roughage and the protein supplement was supplied in 43% protein cottonseed meal, whole cottonseed, and and 28% protein whole pressed cottonseed. Hegari fodder with these protein supplements produced lower gains than alfalfa hay.

Agronomic Work

Most of the agronomic work of this station has dealt with the staple crops, cotton, sorghums, and alfalfa, with some small grains and miscellaneous legumes.

Extensive trials with large numbers of cotton varieties have shown that medium early maturing varieties with staple above an inch in length should generally be used. These have included the best strains of Acala, Stoneville strains, and D. P. L. 11A. Since early maturity is combined with high yield and good quality in the Alcala A-37, this strain of cotton is very promising for this area.

Applications of fertilizers have not always given consistent results but phosphorus has generally increased the yield of alfalfa while cotton has responded to some extent to applications of nitrogenous fertilizers. Other materials have had no noticeable effect upon these crops.

After trying numerous varieties of grain sorghums under these conditions hegari is still considered as the most desirable general purpose grain sorghum where the entire plant is ground for feeding, but Red Top sorghum is a close second when used for the same purpose.

Extensive trials with miscellaneous legumes has shown that alfalfa and sweet clover are superior to the others for growing under irrigation here.

Fruit Adaptability Trials

Because of the climatic and other conditions in this area it does not appear to be practical to produce most fruit crops on a commercial scale but every farm might well have a few of the best varieties in favored locations. These plantings should include peaches, plums, apricots, blight resistant pears, and western pecans. Pecans have made a fair growth and produced regularly if located where they can get more than the usual amount of water.

Ornamental Adaptability Trials

During the past several years a large amount of ornamental material has been grown on the Station to test the value of the different varieties

under these conditions. The coniferous evergreens have made an exceptionally good showing. Nearly all types of the arborvitae have done well and also the Italian cypress, Arizona cypress, Pfitzer's juniper, Red Cedar, Ramsey's Hybrid, and many others. Broadleaf types which have done well are the live oak, flowering pomegranate, vitex, flowering willow, Arizona ash, Osage orange, honeysuckle, and black walnut. For a quick growth the cottonwood, Chinese elm, and Russian olive are valuable but very susceptible to the cotton root rot where this diesease is present in the soil.

J. J. Bayles.

SUBSTATION NO. 10, FEEDING AND BREEDING STATION

Substation No. 10 is located at College Station, Brazos county, one mile northwest of the College on the public highway; its latitude is 30 degrees north and its longitude 96 degrees west; it is 308 feet above sea-level. The annual average rainfall over a period of 40 years was 38.02 inches. The land owned and assigned to the Feeding and Breeding Station comprises 920.8 acres.

The work of this station embraces investigations in the feeding, breeding, and management of swine, dairy cattle, poultry, goats, and sheep. Progress of work on projects with these animals is treated elsewhere in this report under the respective divisions concerned.

Of the land embraced in this station, approximately 150 acres are in cultivated crops, 200 acres in improved pasture, and the remaining 570.8 acres in native pasture.

SUBSTATION NO. 11, NACOGDOCHES

Substation No. 11 is located one-half mile north of the city limits of Nacogdoches, Nacogdoches county, on State Highway No. 35; its latitude is 32 degrees north and its longitude 94 degrees west; its elevation is 292 feet above sea level. The average annual rainfall over a period of 28 years was 49.16 inches, with a total rainfall of 68.04 inches for the 1940 season. During this period an average of 15.51 inches, or 31.5 per cent of the total average annual rainfall occurred during the months of May, June, July, and August, but this year 20.71 inches, or 30.4 per cent, has fallen during these months. The average length of growing season during a 27-year period is 247 days, with the average last killing frost in the spring occurring March 13, and the average first killing frost in the fall occurring November 15. The purpose of this station is to serve the region of Texas in which the Nacogdoches soils, or "Redlands," occur. The redlands of the Nacogdoches soil series were among the earliest settled farm lands in the state. The soil in the virgin state is productive, but since much of it has been in cultivation for a long time, one of the chief problems of the station is that of finding the most effective and the

practicable systems of cropping for building up and maintaining soil fertility; other studies concern the use of fertilizers, including rate and time of application, and the development of horticultural and agronomic crops suited to a diversified agricultural program for this region.

Soil Improvement Investigations

Preliminary Studies of Artificial Plats for Field Experiments: The project was discontinued at the close of the 1939 season as five years' results had been obtained. The series of plats were prepared to begin a new project having to do with a study of the residual effects of winter green manures on cotton as compared to cotton grown without a preceding green manure corp and receiving commercial fertilizers.

Fertilizer and Seed Treatment Studies

The cooperative project initiated during the 1936 season on the effect of disturbing the seedbed where applying fertilizer at different positions in relation to the cotton seed, and the use of fungicides on cotton seed prior to planting was continued during the year. The results of the study are reported fully in the Division of Agricultural Engineering.

Green Manure Studies

During the fall of 1937 a project was initiated for the study of the comparative value of oats and Hairy Vetch when used for green manure purposes preceding cotton. A review of the yields of lint cotton obtained during the 1940 season shows the greatest production to have been derived from the areas that did not have a green manure crop turned under but remained fallow during the winter and received 400 pounds to the acre of 4-8-4 fertilizer prior to planting the cotton seed. The treatment of planting Hairy vetch alone with no fertilizer being applied either to the green manure crop or cotton produced the next highest yields of lint cotton per acre. The third high yield of lint was produced by the planting of Hairy vetch plus the fertilizer treatment of 400 pounds to the acre of a 0-8-4 applied prior to planting the vetch. The area receiving no fertilizer or green manure treatment was low yielder for the test again this season. Yields were materially reduced again this season on areas that had three consecutive crops of green manure, mainly of Hairy vetch, turned under, by the early appearance of Fusarium wilt and nematodes. Due to significant increase in the loss of plants this season the yields from a number of the replications were not included in the averages.

Records obtained on the amount of green manure turned under showed the largest yield was from the planting of oats and Hairy vetch that received 400 pounds to the acre of a 0-8-4 fertilizer applied prior to planting the manure crop.

Agronomic Crop Investigations—Cotton Varieties

Fourteen commercial cotton varieties and four strains of the Half & Half x Lone Star cross were grown in the 1940 test with six replications being used. Half & Half made the highest average yield with 391 pounds of lint per acre, 7/8 inch staple, and 42.7 per cent lint; a strain of Half & Half x Lone Star (7-25-p37) was second in yield with 331 pounds lint to the acre, 15/16 inch staple, and 41.7 per cent lint; the third most productive was Deltapine 11A with 324 pounds lint to the acre, one inch staple, and 38.2 per cent lint; another strain of Half & Half x Lone Star (7-25-p3) was fourth in yield with 306 pounds lint to the acre, 29/32 inch staple, and 41.5 per cent lint; and a third strain of the cross between Half & Half x Lone Star (14-47-p18) was fifth in yield with 298 pounds lint to the acre, 15/16 inch staple, and 42.0 per cent lint.

Cotton Breeding

In a continuation of the cotton breeding work of this station, fifty-six progeny rows of the 1939 selection of Half & Half x Lone Star cross, selfed strains of Greer and Deltapine 11A, were grown for further selfing and selection.

Selfed and hybridized seed secured from work done during the winter of 1939 and 1940 in the greenhouse on back-crosses between Half & Half x Lone Star, Greer, and Deltapine 11A, were planted to the field for further selfing of the selections.

The randomized field yield strain test was continued this season with 18 strains of the Half & Half x Lone Star, 4 selfed strains of the Greer selection, 5 selfed strains of the Deltapine 11A selection, and the commercial varieties of Half & Half, Lone Star, and Deltapine 11A, planted in six replications.

The five highest yields were obtained from the following listed in order of yield: Greer p34, 479 pounds lint; Deltapine 11A (Commercial seed), 418 pounds lint; Deltapine 11A p29, 396 pounds lint; Deltapine 11A p31, 383 pounds lint. Half & Half x Lone Star (7-25-p37), 383 pounds. Six strains of the Half & Half x Lone Star cross were more productive than the parent Half & Half, while fifteen strains of the cross produced more lint than the parent Lone Star.

Corn Inheritance and Improvement Test

The work at this station pertaining to the improvement of corn for this section continues the work in the development of a yellow prolific variety. The 1940 work consisted mainly of combining several of the outstanding strains selected from previous field yield strain tests. The selected cross-pollinated strains are to be further subjected to field tests and then the oustanding ones are to be increased for distribution.

Additional work was done this season in cross-pollinating and selfing certain strains of the Texas Golden Prolific x Yellow Surcropper in an effort to secure an early maturing prolific yellow corn and reduce the height of the stalk. The prolific character is to be sacrificed to a minor extent in order to increase the size of the ear. Ample seed supply was secured from more than 500 selfed ears from plants producing three or more ears.

Horticultural Crop Investigations

The variety test project of the blackberry and dewberry was discontinued following the 1939 season.

Blackberry and Dewberry Breeding

The breeding work on Rubus at this station during 1940 consisted of securing detailed data on fruit and vegative characters of approximately four thousand seedlings. Approximately 250 seedlings had outstanding characteristics that justified further observation.

Adaptability Investigations With Fruit Crops

During the year further material was assembled for the adaptability study of fruit varieties in East Texas. The station orchard consists of 262 varieties and selections of peaches, 15 varieties and selections of plums, and six varieties of pears.

Progress Report No. 701, Peach Varieties for East Texas Home Orchards, sets forth a brief description of 24 peach varieties that have been especially promising at this station. This is a list of varieties that will provide fruit from late May through the latter part of August.

The plum varieties, Six Weeks, Methley, Bruce, America, and Gold, continue to be outstanding in yield of fruit and for home consumption.

Continued studies were made on the cold requirements of 47 varieties of peaches during the 1939-40 season. An ample number of cold-hours were had during the winter for fruit-bud development. However, due to a killing frost with a minimum temperature of 29 degrees on April 13 a number of varieties lost a large per cent of the young fruit but no one variety lost its entire crop.

Control Methods of Peach Insects and Diseases

Studies made towards the control of the peach insects and diseases in cooperation with the Division of Entomology and Division of Plant Pathology and Physiology and the results obtained are reported fully by these cooperating Divisions.

Ornamental Adaptation Study

The purpose of this project is to have at this station specimens of both local and foreign plants in order to accumulate ecological data for the

local nurserymen and landscape gardeners. A large portion of the material is used in developing the landscape design of the station farmstead. Such material included in the test this year does not have sufficient promise as to merit its being described in detail.

Tung Oil Studies

All work in regard to the adaptation of the Tung tree to this section was discontinued following the 1939 season.

Slash Pine Adaptations Studies

A cooperative project on the adaptation of Slash pine to the Nacogdoches soils is being conducted with the Texas Forest Service. Growth records obtained during the 1940 season showed an average growth during the first six months of 24.6 inches, and a growth of 15.3 inches average for the 72 trees during the second six-month period. Diameter measurements at the end of the 12-month period showed the ten-year-old trees to have an average of .7 inch increase; the average diameter of these trees is 4.2 inches. The average height of all trees at the end of the season was 22.1 feet, with the tallest being 28.9 feet. Due to very favorable rainfall distribution during the season the growth of the trees during the last six months of the year exceeded by far the increase in height made during the same period of months of previous years.

Post Treatment Studies

No increase in the amount of material to be studied was made in this test during the 1940 season. Observations on the posts show that untreated pine posts are decaying rapidly at the ground line and will require replacing before two years' usage. No appreciable rate of deterioration could be noted at the end of one season's test on the posts receiving preservative treatments.

H. F. Morris, Superintendent.

EAST TEXAS PASTURE INVESTIGATIONS, LUFKIN

This field laboratory is located six miles west of Lufkin, Angelina County, on State Highway No. 94 with a latitude of 31 degrees north and a longitude of 94 degrees west. The laboratory's elevation ranges from 217 to 270 feet, and it covers a total of 228 acres. The majority of the land is utilized for grazing and timber production studies. The timbered pasture land comprises about 150 acres and most of it is covered with young pine and native hardwoods. Some culling and thinning has been done in nearly all of this timber in addition to cutting the underbrush. Goats are helping keep the sprouts and brush partly in check, which usually return after such cultural methods.

The average annual rainfall since the beginning of the laboratory in 1934 through 1940 is 49.87 inches with extremes of 38.51 inches in 1936

to 62.97 inches in 1940. In general, the rainfall is poorly distributed, thus making the total annual figures somewhat misleading. As for example, the total rainfall for 1939 was 48.65 inches, yet the majority fell in January, February, November and December, leaving the growing season, especially the latter part, one of the driest ever recorded in this vicinity. The average length of the growing season is between 250 and 260 days. Until weather recording instruments other than a rain gauge are installed, such information as temperature, atmospheric humidity, evaporation, and wind movement obtained at Substation No. 11, Nacogdoches, must be considered applicable to this location.

According to a detailed soil survey made by the Soil Survey Division of the Experiment Station, there are five different soils on the laboratory's land; namely, Lufkin very fine sandy loam, Lufkin very fine sandy loam steep phase, Caddo fine sandy loam, Caddo fine sandy loam slope phase, Bibb fine sandy loam, and Bibb silt loam. These are the final names, those given in the report last year were only field names. These soils are characteristic of a great part of the land in the East Texas Forest Region, and, in general, are identified by a grayish sandy top soil with a very tight subsoil of approximately the same color. They range in acidity from medium to high. From the standpoint of good pastures and good livestock, soil fertility is probably the main limiting factor in this region; however, these soils respond readily to most fertilizers and good treatment. Therefore it is possible to overcome at least part of this limiting factor.

Well water of sufficient strength for average livestock waterings may be found in the area at depths of from 80 to 120 feet. At present creeks, rivers and surface tanks water most of the animals. Where wells are used there are few that are pumped by windmills, evidently because the amount of wind is not great enough after it gets through the timber.

The shrubby plants on the laboratory consist of French or Spanish mulberry, yaupon, and wax myrtle, and the browse furnished by these is of little if any value. Species of sage grass and many other coarse, rather tall, bunch-type grass, making up the majority of the native forage coverage, are of little value, except for a short period in the spring. The nutritive value of these grasses is considered low at all times. There are no sod forming grasses in the native grass coverage unless Bermuda and Carpet are to be considered native plants.

There are one million or more acres of cut-over pine and hardwood forest land in East Texas that are not reproducing timber, and in general this acreage is not being utilized efficiently for any other purpose. This land carries some livestock, especially cattle, but usually they are small in size and poor in quality. With such a vast acreage of land lying more or less idle, the people wanted to know whether or not it could be converted into good grazing land.

For the purpose of conducting the research necessary to properly answer this question, the field laboratory was established in 1933. The first research was to determine why the cattle in the region did not attain normal size. It has been shown that high-grade Herefords would attain normal size and become fat on pasture here, if grazed on an improved pasture, given plenty of fresh water and salt, and maintained during the winter with supplemental feed. The next step was to determine to what extent the land could be profitably improved for pasture. Eight 5-acre pastures were improved to the point that they would carry around thirty head of cows with calves for 260-290 days per year. The cost in improving this acreage was not considered prohibitive when the heavy carrying capacity was considered.

Later, high-grade Angora goats were brought to the station to observe their adaptability, and the observations obtained have shown that Angoras can be expected to shear well, but not to raise kids satisfactorily. This leads to the belief that good-shearing wether goats may be used profitably in the livestock set-up. Sheep were placed on the station this year to study their value and adaptabiliy. Most of the older studies are being continued in order to check the original indications obtained, and these tests have given rise to numerous smaller tests either directly or indirectly concerned with the main problem.

Livestock and Pasture Improvement Investigations

With the exception of another low per cent calf crop and failure of the cows to settle readily, the herd of high-grade Herefords continued to thrive throughout the year. In the spring the 23 six-year-old cows made average gains of as high as 4.5 pounds per head daily for a 28-day period. Abundant grazing in clover on the improved pastures was largely responsible for these high gains. This placed all the cows in high condition and the majority remained in such condition for the balance of the year, going into the winter with an average weight of 1235 pounds. The four three-year-old cows that are out of the old cows and dropped on the station, performed almost as well as the older cows during the year as to gains and much better than the older cows performed during 1937, when they also were three-year-olds. Here are the comparative weights of both groups as three-year-olds past after weaning the calves in the fall; old cows weighed 911 pounds on October 27, 1937; young cows weighed 1011 pounds on October 29, 1940. The old cows weaned a 67 per cent calf crop in 1937 whereas the calf crop from the young cows, though smaller in number, equalled 75 per cent. This indicates that good Herefords will not degenerate in this region if they are furnished good pasture and fed in the winter.

Because of difficulty in getting the cows with calf during the previous breeding season, the crop was late this year with most of the calves being dropped in May and June. Usually late calves are handicapped by the hot weather and do not make as good growth as calves born early enough

to get a start before summer. However, these calves were heavier at weaning than our early calves had been. Several weighed nearly 500 pounds at this time—six months of age. No doubt the unusually low summer temperature and the consistently good pastures, caused by desirable distribution of the rainfall, were the main factors contributing to such heavy calves.

All the calves were sold or will be in the near future, excepting two bull calves saved for experimental purposes. Five calves out of the bunch were considered undesirable for sale as potential breeding animals. From the time they were large enough to eat until weaned or sold, all the calves were fed a small amount of whole oats and cottonseed meal every other day.

Breeding and Calving Problems: It was mentioned under this heading in last year's report that the four-year-old herd bull, not normally fertile, was replaced by a young bull known to be fertile. The older bull was sold for slaughter, then later it was discovered that he had settled 15 out of 23 cows before being sold. The younger bull failed on the remaining 8 cows, and in 1939 he definitely settled only one cow but may have settled four others. This performance made it necessary to borrow a bull from a nearby rancher. The borrowed bull was the sire of from 14 to 18 of the 19 calves dropped this year.

The eight cows that were not settled by either of the bulls in 1939, were served by the young herd bull each heat period from the close of the regular season on through the winter and spring in an effort to get them settled. These cows were examined by Dr. R. D. Turk on September 3, 1940; four were pregnant, two had cystic ovaries, and the other two had normal ovaries but were not pregnant. Two of the cows found to be pregnant have already calved. One of the calves was born dead. Thus the young bull settled 50 per cent of these cows that failed to breed in 1939, but with the other calf known to be sired by him, the calving record shows only three calves to his credit since placed in service in 1938.

In connection with these problems, an encouraging thing happened this year in that six cows became pregnant while calves were at their sides. Heretofore all wet cows, with exception of one, had not become pregnant until at least after their calves were weaned.

It was necessary to use the young herd bull again this year regardless of the past performance, and again only a small per cent of the cows were settled by September. At this time a Guzerat Brahman bull, borrowed from the Hudgins Ranch, Hungerford, Texas, was placed in service. Apparently he had settled all the cows except one or two by the time he was returned to the ranch the first part of December.

There is still no definite proof as to where the fault lies in these breeding and calving difficulties; whether with the bulls, the cows, or both the bulls and the cows. But it is thought that the problem, whatever the cause may be, is more or less common to the region and not confined to the station's cattle.

Bonemeal vs. Dicalcium Phosphate: This study, begun November 2, 1938, was closed October 29. 1940. It was designed to compare dicalcium phosphate with feeding bonemeal as a source of phosphate when mixed with salt and fed as a lick.

Based on the weights and calving record, there seems to be very little difference between the two minerals. It is certain, however, that dicalcium phosphate was not palatable to these cows, whereas the bonemeal mixture was palatable.

Winter Feeding: The supplemental winter feeding ended last winter on March 16 and was started this fall on November 14. Last winter's feeding was considerably greater than usual because the most severe cold weather since establishment of the station was encountered during January and February. Feeding was begun early this fall because the calves were still with the cows and they were too young to wean until December. Thus it was not possible to take the late calves away from the cows in time to give the mothers a chance to rest and regain lost weight. Silage, cottonseed hulls, and cottonseed meal constitute the principal winter maintenance ration. For the second consecutive year the silage being fed this winter was made of Red Top sorghum. About thirty tons were ensiled in the trench silo.

Improved Permanent Pasture Grazing: The cattle herd was turned on these pastures March 4 where it remained with the exception of a few days until November 24. Throughout the growing season the pasture forage was excellent. This excellence was due no doubt to good distribution of rainfall during the period and lower than usual temperatures during the summer months. Approximately five acres of improved permanent pasture on the upland were added this year, which allowed still more freedom for handling the cattle, for practicing controlled grazing, and for making further management studies. The total 47 acres furnished a majority of the year's grazing for the 27 grown cows and their 19 calves, the herd bull, and a milch cow and calf; and grazing for a part of the year for approximately 50 head of goats and a saddle horse.

Presence and Abundance of Cattle Grubs: We continued to examine the cattle for grubs during the required months, and to make reports of same to the Division of Entomology. This work will be reported by the Entomology Division.

Angora Goats: The 1939 accumulation of mohair was sold January 11, 1940 by the Sonora Wool & Mohair Company at 80 cents per pound for the kid hair and 55 cents for the grown hair. Therefore the quality and grade of the hair produced here is evidently about as good as that grown elsewhere.

From the eleven does, eight kids were dropped, one was killed by drenching and five were raised. This percentage kid crop was much better than we had obtained in the past, and it makes the possibility of raising Angoras here somewhat brighter.

The eleven does, one aged buck, and one yearling buck sheared an average of 2.5 pounds in the spring after they had begun shedding. In the fall the eleven does averaged 4 pounds 6 ozs., and the aged buck sheared 7 pounds 11 ozs. The kids averaged 1 pound 8 ounces.

Stomach worms gave more than usual trouble during the year, perhaps because of the frequent rains. The goats were drenched once and given tetrachlorethylene capsules twice. They were dipped once for lice in wettable sulphur.

The entire group of does, including common and half-breed Angoras as well as the Angoras raised a 100 per cent kid crop. Crossing the Angora buck with the common and half-breed does continues to look promising. The purpose of this cross is to determine whether the mohair of the Angora and the hardiness of the common goat can be profitably combined in the offspring.

Sheep: Ten head of young native ewes were purchased in the lower part of Angelina County last March and brought to the station for observation and a breeding study. These ewes were selected to be as nearly typical as possible of native sheep located in the region. These sheep are poorly covered with rather long coarse light-shrinking wool—a twelve month growth of which weighs from three to four pounds. They appear to have descended from some of the mutton or long wool breeds. They are leggy but fairly large in size. Their chief asset is ruggedness. These ewes are being crossed with a good average Rambouillet ram bred by the Division of Range Animal Husbandry and especially selected for resistance to intestinal parasites. It is hoped that from these matings will come a sheep that is well adapted and that will shear a reasonable amount of medium quality wool.

Permanent Pasture Studies: These investigations are a continuation of those that were outlined and begun several years ago. Korean and Kobe lespedeza were planted in three of the bottom pastures and on the upland pasture in the spring in an effort to get lespedeza back into the pasture mixture in more abundance. It has become evident in the last three years that the clovers and lespedezas will have to be separated in order to obtain best results from both. When mixed and under our system of management the clovers apparently prevent germination of the lespedeza on account of the abundance of clover in the spring. A good germination was not obtained, but grazing on the pastures where the lespedezas were planted was deferred in the fall in order to allow grasses to grow dense and tall. This sort of treatment will apparently prevent germination of the clovers. So far little if any clover has appeared.

In addition to furnishing the grazing mentioned under another heading in this report, approximately 600 bales of clover hay were cut from the improved permanent pastures last spring.

None of the introduced forage plants showed any promise during the year.

Temporary Pasture Studies: Alysicarpus vaginalis was planted for grazing for the second consecutive year. As was discovered the first year, these plants grew too slowly and, encouraged by frequent rains, weeds soon covered the plants so completely that it was useless to attempt cultivation.

A planting of pearl or cat-tail millet as a substitute for Sudan grass exhibited some promise. It was relished by the livestock, and made more rapid growth after being grazed than Sudan grass. Further trials will probably be conducted with this plant.

The small acreages of New Nortex Oats, wheat, barley, hairy vetch, and wild winter peas, reported as planted in the fall of 1939 for studying their value for winter grazing were not satisfactory.

Sugar Cane Studies

With the thought that sufficient information has been obtained after six years' study, the test on sugar cane varieties was closed this year. However, a test on fertilizers was begun, in order to obtain more information as to the fertilizer requirements of sugar cane grown for sirup.

The treatment and yields in this year's fertilizer test are as follows:

	Treatment, pounds	Acre yield sirup, gals.
Cottonseed meal	300	115
Nitrate of soda	125	121
4–8–4*	500	158
8–8–4*	500	144
4–8–1*	500	179
4–8–0*	500	96
Untreated		111

*Nitrogen in nitrate of soda.

Variety C. P. 807 was used for this test. All the yields are considerably lower than average because of unsatisfactory growing conditions for sugar cane.

E. K. Crouch.

TOMATO DISEASE LABORATORY, JACKSONVILLE

Resistance of Tomato Varieties to Fusarium Wilt

Valuable wilt resistance was found in Glovel, Morse 113-6, Stokesdale, and John Baer (resistant strain) of tomatoes in addition to those previously reported. Bison and North Dakota "40" varieties are dwarf types very susceptible to wilt.

Wilt Resistance Decreased by Root-Knot

Summary data for the last 2 years confirm the earlier conclusion that tomato wilt resistance is decreased prominently by root-knot. Wilt resistance was decreased 7 to 38 per cent by root-knot in 22 varieties of tomatoes. A wilt immune selection remained immune to wilt despite severe damage by root-knot.

Effect of Wilt Resistance on Tomato Yields

Even in an epidemic of Fusarium wilt, marketable yields of 6 to 7 tons of fruit were harvested from Break O'Day, Illinois Baltimore, Marglobe, Michigan State, Pritchard, Rutgers, and "white-flowered" tomatoes which are wilt resistant. In contrast, Bonny Best yielded only 0.5 ton, and Stone yielded only 1 ton of marketable fruit per acre in representing wilt susceptible varieties.

Wilt Immune Selections of Tomatoes

Marglobe and Rutgers tomatoes crossed with wilt immune strains remained immune to Fusarium wilt in the fields. They were extra early and had the excellent horticultural qualities of their commercial parents.

New Golden Tomato Immune to Wilt

Selection T550 was immune to wilt and bore golden (Cadmium yellow) fruits of 6 x 6 lug size. The wilt immunity and richer color make this selection superior to Golden Queen and Yellow Ponderosa varieties that yield poorly here.

Resistance of Tomato Varieties to Blossom-end Rot

A randomized yield test of tomato varieties was conducted practically without complication from wilt. Marglobe and Pritchard varieties gave the best yields, producing more than 8 tons of marketable fruit per acre. Pritchard, Marglobe, and "white-flowered" tomatoes were strongly resistant to blossom-end rot. Grothens Red Globe, Gulf States Market, Illinois Baltimore, and Rutgers were seriously susceptible, while Louisiana Red and Buckeye State were extremely susceptible to blossom-end rot. An unusual symptom of blossom-end rot appeared in wet weather when many tomatoes showed uneven fruit surfaces with brown areas indicating internal brown tissues.

Inheritance of White-Flower Character of Tomato

This year, test of 15 selections with 558 tomato plants of heterozygous ancestry resulted in 75.1 per cent of the progeny plants with yellow flowers and 24.9 per cent of the plants with white flowers. This typical 3:1 ratio confirms the evidence reported earlier. Four homozygous selections gave 192 plants all of which had white flowers.

Striped Tomato Fruits With Pock Marks

One tomato selection had dark green stripes in the peel of the fruits. In ripening, some of these fruits developed corky pits resembling fruit pox, indicating a possible genetic origin of the pock marks in this case.

Lycopersicon Esculentum X L. Peruvianum

Lycopersicon peruvianum was used to pollinate commercial varieties of *L. esculentum*, and normal Marglobe-type fruits resulted in the parent generation. Twelve of these fruits contained only dwarfed, possibly sterile seeds of the size of the seeds of the male parent.

Complicated Inheritance of Fruit Color

Hybrid tomatoes with *Lycopersicon chilense* were back-crossed onto commercial varieties and produced a large percentage of sterile plants with intermediate leaf types. A few of the fertile plants bore red or pink fruits but most of them bore fruits with an unusual shade of yellow color.

White-fruit Character of Tomato

Crosses with Michigan State and Riverside tomato varieties gave evidence that the white-fruit color is recessive to red-fruit color in Frew's Snow Ball tomato.

A Large Super-puff Selection of Tomato

Selection T480 appeared as 1 plant in a field of Rutgers tomatoes. The progeny plants were true to type and bore red, lobed fruits 1.5 to 2 inches in diameter. They were 3 to 5 lobed with large air spaces in most of their locules.

Genetics of Tomato Fruit Puffing

Garraprihe tomato has red fruits 1 to 2 inches long and 1 inch in diameter, and most of the fruits are hollow like pepper fruits. Crosses of Garraprihe with Marglobe, Riverside, and "white-flowered" tomatoes gave an F_1 progeny of 109 plants all of which had fruits with nearly all of the locules hollow. The puff character evidently was dominant in this combination. Fruit size and leaf type were intermediate in inheritance.

Diseases of Tomato Leaves and Fruits Avoided With New Chemicals

Summary data from the last 3 rainy seasons show that early blight and bacterial nail-head rust (prevalent diseases) were greatly delayed in appearance and caused little damage to tomatoes sprayed with Basicop, Copper Hydro 40, or Z-O. Such tomatoes gave average yields 10 to 13 per cent larger than the yields of the unsprayed check rows. These new chemicals merit recommendation for commercial use in East Texas. They cost less than Bordeaux mixture and are less injurious to tomatoes in dry weather.

Light Controlled Post-emergence Damping-off of Tomato Seedlings

In replicated tests with untreated seed and soil, 40 per cent of the tomato seedlings died of post-emergence damping-off when grown in the dim light of the laboratory, while less than 1 per cent of the seedlings died of post-emergence damping-off when grown with adequate light out-of-doors in May.

Perfect Control of Root-knot Nematodes by Soil Fumigation With Chloropicrin

To avoid recontamination of disinfected soil, 12 plots were protected with sheet-metal borders 30 in. deep with all of the plots surrounded with a woven-wire fence. Watermelon and okra plants were used to test the soil for nematodes. The 3 plots fumigated with 500 lb. of chloropicrin per acre and covered for 5 days with glue-coated paper produced 617 test plants entirely free from root-knot. Similarly treated plots with water instead of paper covers produced test plants with only a trace of root-knot. In the 11 untreated plots, 91 per cent of the test plants showed severe root-knot. The new cloth covers were only partly effective in confining chloropicrin in the soil. In later tests, ethylene dichloride was injected into the soil at the rate of 1500 lb. per acre but apparently it did not affect the population of root-knot nematodes in the soil, as only 22 to 38 per cent of the test plants remained free from root-knot in the untreated plots and those fumigated with ethylene dichloride. In contrast, chloropicrin gave nearly perfect control of nematodes in comparable plots.

Miller 610, a Commercial Variety of Wilt Resistant Cotton for East Texas

The regional cotton variety wilt test was continued in cooperation with the U. S. D. A. using 600 lb. of 6-6-6 and 6-12-6 fertilizer per acre in land abundantly infested with *Fusarium vasinfectum*. Miller 610 cotton averaged 2027 lb. of seed cotton per acre which was 82 per cent more than the yield of comparable Half and Half Cotton. Dixie Triumph 06 yielded 1898 lb. of seed cotton per acre and Wannamaker's Early Wilt Resistant cotton yielded 1828 lb. of seed cotton per acre. All varieties yielded better with 6-6-6 fertilizer than with 6-12-6 fertilizer possibly due to excess phosphate from residue in the soil. Miller 610 cotton appears to be well adapted and valuable for commercial use in East Texas as it has showed strong wilt resistance, long staple, large bolls, and high yielding capacity in dry and wet seasons of the last 4 years. It has been satisfactory in commercial tests for the last 3 years.

Tests of Cotton Varieties for Resistance to Root-Knot

Acala, Clevewilt, Cook 144-68, Delfos 965-425, Deltapine 12, four strains of Dixie Triumph, Half and Half, Lankart, Lone Star, Miller 610, Qualla, Rowden 2088, and Toole (Perry) varieties of cotton all appeared to be very susceptible to root-knot caused by *Heterodera marioni* as nearly all of the plants tested bore abundant root-knots in Fields B and R. Rhyne Cook appeared to be a little resistant to root-knot.

P. A. Young.

SUBSTATION NO. 12, CHILLICOTHE

Substation No. 12 is located four and one-half miles south and one mile west of Chillicothe, Hardeman County, longitude 99 degrees west and latitude 34 degrees north and elevation 1406 feet above sea level. The Station serves a region in the upper Red River Valley where cotton, wheat, and sorghum are the principal crops. The soils of this part of the Rolling Plains area are predominately of the Vernon, Foard, Abilene and Miles series. The average annual rainfall at this point is almost 25 inches.

The Station was established in 1905 on leased land as a forage crop testing station operated by the United States Department of Agriculture and the Texas Agricultural Experiment Station. The cooperation has continued to the present. In 1916 the State of Texas purchased 100 acres of land which comprises part of the present station and subsequently an additional 152 acres was acquired so that the present station consists of 252 acres.

During the early years an important phase of the work consisted of testing crops recently introduced from foreign countries and this early work resulted in the introduction of Sudan grass and the grain sorghums Hegari and Feterita and in the distribution of Dwarf Yellow milo.

In common with others, this station is collecting reliable information on the procedure in crop production and soil management. Varietal and cultural experiments are being made with all the important crops. Some attention is being devoted to vegetables and fruits for production in home gardens and orchards and to ornamental plantings of trees and shrubs.

The unique feature of the work at this station is the investigations under way with sorghums. The most complete nursery of both forage and grain types of sorghums in America is maintained at this point. An intensive study of sorghum inheritance is under way and the production of new and superior varieties is the aim of an inclusive breeding program.

Experiments with Sorghums

(In Cooperation with the Bureau of Plant Industry, U. S. D. A.)

Sorghum Variety Test: On account of an unusually heavy infestation of Chinch bugs an unsatisfactory crop of grain sorghum was produced. There was damage to all varieties but such susceptible varieties as milo suffered the greatest damage. Since the season was relatively favorable from the standpoint of rainfall the yields were quite largely a reflection of Chinch bug resistance.

The pure milos produced practically nothing. Reasonably good yields of grain were produced by such varieties as Feterita, Chiltex, Ajax, Club, Kalo, Darso, and Early Hegari.

It is believed that the considerable acreage planted to barley has been a contributing factor in the increase of the Chinch bug infestation. The

winter was without a prolonged spell of damp weather and Chinch bugs were present in barley in such numbers that the barley crop was a failure. As the barley crop approached maturity the insects flew from the fields and were so numerous that sorghum fields several miles removed from a small grain field were seriously infested. It appears that the acreage planted to barley may have to be drastically curtailed if the Chinch bug infestation is to be kept within bounds.

Chinch bug resistant varieties of grain sorghum have been produced but even these resistant varieties are damaged by such an infestation as occurred this year. The production of a Chinch bug resistant barley would result in a smaller Chinch bug population and this would be desirable.

Yield of Pythium Resistant Strains: Milo Root Rot *(Pythium arrhenomanes)* was virulent in the area of the state from Abilene north and the contrast between resistant and susceptible strains was very marked. The production of resistant strains was reduced by the Charcoal Rot disease another disease that is now widespread in its distribution. Strains resistant to Pythium produced in the neighborhood of 15 bushels per acre and the susceptible strains died without producing seed.

There is now a strain of Sumac (Red Top) sorgo being grown in Northwest Texas that is susceptible to Pythium Root Rot. This susceptible strain produced approximately 1/3 as much forage as the ordinary strain of Sumac which is resistant to the disease. The susceptible strain is earlier than the ordinary strain of the variety. The presence of this susceptible strain is serious at a time when the AAA program is stimulating the growing of sorgo because the demand for seed is so great that there is less than the usual attention being paid to sources of seed.

There are now resistant strains of all important varieties with the possible exception of Wheatland and under these circumstances there is no reason for farmers to suffer the losses from Pythium Root Rot that some of them are experiencing.

Sorghum Breeding: The program of producing Pythium Root Rot resistant strains of the important commercial varieties was considered complete when resistant strains of Darso, Early White milo, Sooner, and Double Dwarf milo were distributed last year.

The very serious Chinch bug infestation of 1940 offered an opportunity to observe the results of the selection for Chinch bug resistance that has been done in past seasons. It was gratifying to find a number of progenies of milo type and maturity that proved to be quite resistant to this insect. This material is 7/8 milo and 1/8 Leoti sorgo. Another back-cross has been made to milo and it is believed that selections resulting from this last back-cross will be worthy of distribution.

The Charcoal Rot disease was again virulent but no progress has as yet been made in selecting a resistant type of milo.

Sudan Grass Breeding: The work in producing a non-seed-shattering, sweet-stemmed, juicy Sudan grass of distinctive seed color is approaching completion. Sweetness, juiciness, non-shattering seed habit, a certain amount of resistance to several foliage diseases, and sienna glume color have been introduced into Sudan grass by crossing with Leoti sorgo. The breeding process has consisted of back-crossing several times to Sudan grass with selection following each hybridization. It appears that the first increase of seed of the new strain might be made in the spring of 1942.

Hybrid Vigor in Sorghum: To make the hybrid vigor of plants grown from crossed seed available to farmers an attempt is being made to develop a practicable method for producing hybrid sorghum seed in large quantities. In this project a character called male sterile is being used. No pollen is produced in flowers of male sterile plants although the female parts of the flower are functional, and consequently any seed produced is a result of cross pollination. The male sterile character has been introduced into a large number of varieties and strains, and selections are being made to isolate types with better than average seed setting qualities.

In the 1940 breeding block male sterile plants in a number of these lines produced average yields which varied from 27 per cent to 62 per cent of those made by normal self-pollinated plants in the same lines, although in the original male sterile kafir stock the male sterile plants produced only 9.4 per cent as much seed as normal plants. If seed set on male sterile plants can be maintained at 50 per cent of the yield of normal plants while these lines are being further purified for other characters such as seed color, height, etc., it appears that perhaps a substantial basis for commercial hybrid seed production will have been attained.

Inheritance Studies: This work which comprises one of the major activities at this Station is resulting in the accumulation of knowledge of the genetics of sorghum that is contributing to the breeding program with sorghum in this as well as other states. During recent years this particular phase of work has been enlarged as the result of support received from the Work Projects Administration in the way of labor and laboratory assistance.

Genetic investigations were continued during the year but no particular phase of the studies was brought to completion. Preliminary results from F_2 coupling data indicate the genes for male sterility, awns, and one of the virescent yellows occur on the same chromosome in the order named with crossing over of approximately 10 per cent between the genes for awns and each of the other characters.

Brown nucellar layer (B) has been reported from this and other stations as simple dominant to nucellar layer absent (b). In the cross Blackhul kafir x Shallu Agros. 2650, both of which are white-seeded without the brown nucellar layer, the F_1 has brown nucellar layer present and the F_2 segregates 9 brown nucellar layer present to 7 absent indicating a second factor for nucellar layer.

The mode of inheritance of "adaptation genes" is being studied. Such genes have a major effect on adaptation and are apparently genes that control plant response to length of day, temperature, and nitrogen nutrition level. A summary of this work is included in the report of the Division of Agronomy.

Cotton Experiments

Cotton Variety Test: Production in 1940 was slightly above one-half bale to the acre. The season was favorable except that the killing frost was followed closely by a hard freeze that damaged the largest top crop that has set in recent years. Deltapine which has not previously performed well at this Station was one of the varieties of greatest production. Mebane 140, Deltapine, Half and Half, and Jumbo produced more than 300 pounds of lint to the acre. With the exception of Deltapine these highest yielding varieties are ones with short lint. However, Mebane 140 and Jumbo have consistently produced ⅞ inch or longer cotton. Acala No. 8 which has been grown for a number of years as a staple cotton in this territory produced 83 per cent as much as Deltapine and Mebane 140.

Cotton Breeding: Breeding work with cotton has been curtailed somewhat since Mebane selections 140 and 141 were distributed. Western Mebane 141 is no longer being increased since it is being maintained by a commercial breeder and is being produced by two commercial seed growers under the name of Western Prolific. Western Mebane 140 continues to be increased and a five acre breeding block is used to maintain the purity of the strain and as an area on which to produce foundation seed for the production of State Certified seed by a commercial seed company. About 200 progeny rows of a Lankart x Mebane hybrid were grown and a selection from this cross has been released to a seed grower who intends to increase it for commercial distribution. This strain was the highest producing variety in the cotton variety test in both 1939 and 1940 and has lint of good quality and staple.

Cotton Fertilizer Test: This test using commercial fertilizers, cotton seed meal, and barnyard manure has been conducted for thirteen years using the same area for each treatment during the entire thirteen years. The results indicate that fertilizer applications have not resulted in increased yields. On the other hand the fertilizer treatments have not been detrimental. Applications of barnyard manure have been no more effective in increasing yields than other treatments. The average lint yield on the plats that have received 5 tons of barnyard manure per year per acre for 13 years is 193 pounds. The corresponding yield of the plats of no treatment is 205 pounds. The soil is Abilene fine sandy loam and it is apparent that available plant food is not a limiting factor in production.

Experiment With Corn

Golden June Corn Breeding: Breeding work with the Golden June variety continued with the object of improving grain color and increasing

uniformity. The grain color has been greatly improved in a period of five years and undesirable plant types are disappearing.

Corn Variety Test: Corn production was not good because of a period of hot weather during July when the crop was making grain. Favorable moisture conditions existed throughout May and June and early varieties had a distinct advantage. The early hybrid varieties therefore produced considerably more grain than adapted Texas open-pollinated varieties but produced no more than Hays Golden an early open-pollinated variety from Kansas. The hybrid varieties of later maturity were in most cases not much better than open-pollinated varieties of similar maturity but yields were only about 5 bushels per acre so that no great difference in production could be expected. Late hybrids with some Corn Belt single cross as one parent and some Texas inbred as the other were slightly better in production than Texas open-pollinated varieties of like maturity. It is believed, admitting that the information on the subject is limited and hardly conclusive, that hybrid varieties adapted to this area of the State will prove to be those that have maturity similar to that of Texas open-pollinated varieties. Such varieties will probably be Corn Belt single-cross varieties crossed to some Texas inbred strain.

The Southwestern Corn Stalk Borer was present in greater numbers than has previously been observed. There seemed to be some varietal resistance and in general there was less infestation in early varieties. It was not uncommon to see as many as two or three worms in single plants of some varieties. This insect presents one more hazard to corn production in this area and one that would probably be too great to overcome if sufficient acreages of corn were planted to allow the insect to become numerous.

Small Grain

(In cooperation with Bureau of Plant Industry, U. S. D. A.)

Wheat Variety Test: The winter wheat crop of this year was one of the poorest on record. Yields were in the neighborhood of 10 bushels per acre. A dry fall and a shortage of moisture in March, April and early May accounted for the poor crop. There was little difference in production among the varieties grown commercially in this territory which are Kanred, Turkey, Blackhull and Tenmarq. A smut resistant variety, Oro x Tenmarq, which has the same adaptation as Tenmarq produced the same as Tenmarq.

Winter Wheat Nursery: One hundred and eight strains and varieties were included using seed obtained from the Denton Station. An inclusive plant breeding program is being conducted by the Division of Cereal Crops and Disease of the U. S. Department of Agriculture in cooperation with the various states and this nursery is being grown for the purpose of testing the many superior strains that have been produced at the Denton Station and in other States. The breeding program has for its aim the

production of good milling varieties that have good production, resistanc to rust and smut, and resistance to lodging and shattering.

Barley Variety Test: The barley crop was practically a failure wit production in the neighborhood of 5 bushels per acre. Although moistur conditions were not favorable, the very poor yield resulted largely fro Chinch bug infestation. Such an infestation developed in barley that th milo crop in this area was practically a failure following the dispersal o the insects from the matured barley crop. It appears that barley acreag may have to be curtailed in this region to protect the milo crop. An generaltion of Chinch bugs in this area is likely to fly and there is therefore, no method of protecting crops from Chinch bug infestation.

There was no significant difference in production between Wintex the two smooth awned Harlan hybrids, and Missouri Beardless. Over period of years, however, Missouri Beardless has been below the other in production largely because of its tendency to shatter.

Soybeans

(In cooperation with the Bureau of Plant Industry, U. S. D. A.)

An effort has been made from time to time in the past to work out successful method of growing soybeans. The procedure has usually bee to procure seed of the varieties being grown in other parts of the Unite States and planting them on two or three different dates. The result in general have been discouraging because the beans produced could no be gathered without loss of a large percentage of the crop from shattering The varieties being grown in the Corn Belt have been the most promisin for bean production but none of the commercially important varieties ha been found to be high enough in production to warrant a recommendatio for West Texas conditions.

Notwithstanding the interest in the crop on the part of farmers an the cottonseed crushing industry all efforts to develop the use of th crop have been without success.

In view of the obvious need for such a crop as soybeans it was decide to make one more effort to find an adapted variety. The Division o Forage Crops and Diseases, U. S. Department of Agriculture has in troduced during relatively recent years a large number of new strain and five hundred and twenty-six of these were grown in 1938. Thos that produced seed in sufficient quantity in 1938 and 1939 were plante in 1940. There were 180 of the original strains still represented. A number o varieties produced as much as 600 pounds of seed per acre and the highes yielding strain, SPI 88471-1, produced 880 pounds of seed per acre. Th highest yielding commercially grown varieties were Macoupin and Lared each of which produced 438 pounds of seed per acre. The yield of the bes strains is just about enough to justify commercial planting were it no for the fact that seed-shattering will not permit the crop to be gathere

without considerable loss. Before the cultivation of soybeans is feasible in this area some way to prevent the loss from seed-shattering must be devised or a non-shattering strain must be found or developed.

Alfalfa

(In Cooperation with the Bureau of Plant Industry, U. S. D. A.)

There is an extensive program with alfalfa under way in several states in cooperation with the U. S. Department of Agriculture and one phase of this program has consisted of making seed of all of the best strains of alfalfa available to those wishing to test them. In view of the impetus given to the growing of alfalfa by the AAA program it was deemed wise to grow these strains at this Station. As a consequence 37 strains were planted in the spring of 1939 and yields were taken for the first time in 1940. A selection of common alfalfa from Virginia was outstanding in production. If this strain maintains its stand and continues its good production, provision will be made to increase it.

Safflower

Safflower (Carthamus tinctoris) is an oil-bearing seed crop that is native to India. The crop was grown here for the first time this year from seed supplied by the Quanah Cotton Oil Company. The seed supplied was of the Russian variety. Planting was done in early April, the crop grew as if it were well adapted, and the production was 970 pounds of seed per acre. The crop is planted and harvested with machinery used for producing wheat. It appears possible that this crop might become valuable in this area.

J. R. Quinby and J. C. Stephens.

SUBSTATION NO. 14, SONORA

Substation No. 14, Ranch Experiment Station, is located on the line of Edwards and Sutton Counties on Highway 55 and comprises 3461.6 acres. The elevation is approximately 2400 feet above sea level. The average annual rainfall over a period of 22 years is 24.12 inches. This year we had 21.03 inches which is 3.09 inches below normal. Most of the rain received this year fell during the first seven months of the year.

All of this station except sixty acres is used for grazing purposes. The sixty acres is used for producing feed crops to supplement the range during adverse range conditions. This station serves the Edwards plateau region of the state where sheep, goats and cattle are the predominating agricultural resource.

Our work embraces three main lines of endeavor as they apply to this particular area. Livestock disease investigations, particularly the diseases of sheep and goats, constitute one part of the station's activities while animal breeding studies and range management investigations occupy the other two major problems which confront the area.

Cultivated Crops, Shrubs, Flowers, and Vegetables

We do not do any experimental work on the production of feed crops but are successful in producing good yields of sorghums about four years out of five. This year we harvested and stored in the trench silo approximately 200 tons of sorghum silage, and stacked approximately 3000 dried bundles. In addition we produced and harvested about ten tons of maize heads.

All of the station residences grow some shrubs and flowers. On account of the limited water facilities at this station chiefly native plants are used for ornamentals which grow well after they overcome the transplanting operations. Very little effort is made to have vegetable gardens but if water were available we could very successfully grow radishes, spinach, onions, beans, beets, carrots, okra, turnips and potatoes. Tomatoes are invariably killed out by a disease believed to be wilt.

Spineless Cactus

The spineless cactus field which was grazed by sheep in 1938 to control bitterweed trouble on the range has made considerable growth since that time. It will perhaps be grown out enough to use again in two to three more years.

Bitterweed Control Studies

The winter of 1939 and 1940 was extremely favorable for the growth of bitterweed. The summer and fall of 1939 were extremely dry with the result that practically no grass cover was procured. This gave the bitterweed seed that was on the ground an excellent opportunity to germinate from the fall rains received in 1939. These weeds had very little competition from other vegetation with the result that the plants made unusual growth and gave all of the areas favorable for their growth the appearance of a sea of gold during the late spring of this year. Even though we had a considerable increase in bitterweed this year as compared to several years past, by actual count we had only approximately 75% as much as we had in the spring of 1931 when the livestock were reduced from 64 units to 50 units per section.

In an effort to find something that would grow during the winter months and compete with bitterweed on hazard areas we planted 2.4 acres of Rescue grass *(Bromus catharticus)* and 4.6 acres of soft chess grass *(Bromus mollis)* in the headquarters field for seed production. Both of these grasses did exceptionally well and in May of this year we harvested 2480 pounds of Rescue grass seed with a combine. We did not get to harvest the soft chess with the combine due to the fact that it did not mature at the same time as the Rescue grass and it was too expensive to have the combine come back. On account of this we cut the soft chess grass with a mowing machine and hauled it out stalk and all to the bitterweed hazard areas around headquarters in June. This grass under these conditions germinated to an excellent stand and is affording excellent

grazing at this time. It is quite probable that it would be of much benefit in the control of bitterweed on these areas if it were so that we could protect it from grazing periodically. Approximately 1200 pounds of the Rescue grass seed was planted in depressions and old lake beds where bitterweed is the predominating vegetation. This also germinated to an excellent stand this fall and is affording considerable grazing at the end of the year. Since this grass is native and we know something of its habits under our conditions, it is quite probable that it will go ahead and make a seed crop even though it may be grazed all winter. It would, of course, be more effective in crowding out bitterweed and would afford more grazing for livestock if it were so we could rest it periodically.

The field on which these grasses were grown was plowed early in the fall with the result that we have another excellent crop which came up volunteer and will be used for seed production for planting in other bitterweed hazard areas.

In Pasture E where deferred grazing was practiced from February until June, 1937, 1938 and 1939, desirable winter growing vegetation has shown 450% increase. Deferred grazing in this pasture was not practiced this year, and it was kept stocked with sheep. Even so, the desirable winter growing plants were in such abundance that a large portion of them went ahead and produced good seed crops. Bitterweed showed a decided decrease over the past years but a large portion of this may be due to its being consumed by sheep in its early stages of growth. The sheep retained in this pasture were fed silage during the danger period of bitterweed poisoning.

W. H. Dameron.

Maintaining Sheep on Bitterweed Range

For four years prior to this we have successfully fed grown sheep on bitterweed range by supplementing the range with sorghum silage over which we sprinkled from ¼ to ⅓ pound of cottonseed meal per head. We had the same success this year with grown sheep. We experienced some trouble from bitterweed poisoning, however, with lambs that were mixed with the grown sheep. Apparently they were too timid to go up to the troughs and eat their portion of the silage. On account of this trouble in the lambs we removed them from the group and put them in a pasture to themselves where they were put on silage and after the amount was built up to three pounds per head daily the trouble disappeared.

W. H. Dameron and O. L. Carpenter.

Animal Breeding Investigations

This station maintains a flock each of grade sheep, Registered sheep and Registered goats used primarily for studies on:

1. Inheritance of polled character in fine wool sheep.
2. Inheritance of the ridgling characteristic of goats.

3. Inheritance of skin folds on Rambouillet sheep.
4. Inheritance of type in Angora goats.
5. Relation of age of animal to fineness of wool or mohair.
6. Determining grades and shrinkages of wool and mohair.

There were 44 registered Rambouillet rams, 275 registered Rambouillet and Corriedale and Rambouillet-Corriedale cross ewes, 64 ram lambs, 63 ewe lambs, 200 grade ewes, 108 grade lambs, 87 registered Angora bucks, 276 registered Angora does, 88 Angora doe kids and 78 Angora buck kids involved in the studies on these projects this year. Individual body, physical and fleece descriptions were recorded on all of these sheep and goats this year. They are reported on under Division of Range Animal Husbandry.

In addition to the registered and grade sheep we maintain 130 ewes for the veterinary department work.

Bitterweed Range Station

(Cooperating with the University of Texas)

The 3160 acres of University land between Ozona and Barnhart, Texas, which was set up for cooperative bitterweed and range study between the University and the Experiment Station during the spring of 1938 has now provided three years study of results of work on this program. The work consists of comparing different systems of pasture and livestock management with sheep and cattle as they relate to production and to range vegetation. The highest production for wool per animal this year was in the pastures where we practiced rotative grazing with sheep and cattle every three months. The wool production in pastures where we practiced continuous grazing with sheep and cattle followed closely that of the rotative grazing plans with the same classes of livestock. The lowest wool production was in the pastures where straight sheep were run on the rotative grazing plan. The average weaning weights for the lambs raised follow the same trend for the three systems of management as the wool production in that Pastures A and B, rotative grazing for sheep and cattle, had the heaviest lambs, followed by Pasture D with continuous grazing, sheep and cattle, with five pounds per head lighter lambs. Pastures I and K, rotative grazing plan with straight sheep, produced lighter lambs by fourteen pounds per head than Pastures A and B.

It must be borne in mind, however, that pastures A, B and D were favored over the other pastures in that the cattle were taken out on account of grass shortage, and the removal of the cattle put these pastures on a half stocked basis as compared to the other pastures which were stocked.

For the cattle the heaviest calves produced this year were in Pastures L and M which are on a deferred grazing plan with straight cattle. It was followed closely by Pasture C which for this year was carrying the cattle for pastures A, B and D on account of grass shortage in those pastures.

Pasture O which is on continuous grazing plan with straight cattle produced 56 pounds per head lighter calves than did L and M, and 30 pounds per head lighter calves than Pasture C. The highest percentage of calf production was in L and M, rotative grazing plan followed in order by Pastures O and C.

The behavior of the vegetation in the pastures will be reported on by the Department of Agronomy under Mr. R. L. Hensel and George Warner.

Bitterweed Pulling

During April and May of this year we destroyed the bitterweed crop in Pasture E by pulling it out by manual labor. The bitterweed infestation was 2.4% of the ground cover. The cost of pulling bitterweed in this pasture was $3.24 per acre. Pasture D, where the bitterweed was also pulled, was done at a cost of 79¢ per acre with an infestation of .8%. The bitterweed infestations on these pastures are to be compared in 1941 with all of the other pastures where the weed was not pulled. This same method of bitterweed destruction is to be followed in these pastures in the future.

Feed for Livestock

On account of the type of country on which this station is located it is quite probable that some supplementary feeding to sheep and cattle would be advisable every winter whether there was a bitterweed crop or not. On account of the bitterweed infestation in this area supplementary feeding to sheep during the winter months is perhaps essential. On account of heavy germination of bitterweed in Pastures I and K, A, B and D, this year we put all of the sheep on the Station on feed on January 14 and fed them until April 2. The sheep from Pastures I and K and Pasture D showed some bitterweed poisoning in January. The sheep from Pastures I and K were poisoned to such an extent that they had to be put in the pen and fed for four days and then released to the pastures again. The sheep from Pasture D showed some symptoms of bitterweed poisoning but did not have to be put in the pen on feed to stop the trouble. All of the sheep on the station were given three pounds of sorghum silage per head to which was added ¼ pound of cottonseed meal. This kind and amount of feed controlled the bitterweed trouble for the rest of the danger period and put all of the sheep in excellent condition for the lambing season which started the latter part of March. This is the second year we have followed this type of feeding procedure on this station with entirely satisfactory results.

During January all of the cattle on the station were put on two pounds of cottonseed cake per head which amount they received daily until April 2. In addition to the cottonseed cake the cattle were given approximately fifteen pounds per head of sorghum silage once a week plus five pounds of alfalfa hay during the winter months to provide some feed with laxative and conditioning effects to supplement the dry grass. In the spring of 1939

we felt there was some vitamin deficiency among the cattle which caused the death of three cows and five calves. Similar trouble was not experienced this year and it is felt that perhaps the feeding of silage and alfalfa was a factor in controlling this condition.

Feed Production

Our feed crop on this station was practically a failure this year due to deficient moisture conditions. Our harvest was 3500 bundles of hegari and cane which was dried and stacked. We were fortunate, however, in having a carry-over of approximately 200 tons of silage from 1939.

The average annual rainfall for the area in which the station is located is claimed to be approximately 20 inches. Our total for this year was 19.09 inches but only 12.06 inches of this fell during the growing season from January 1 to August 31. The balance, 7.03 inches, fell during October, November and December. The late fall rains coming at the end of a summer of badly deficient moisture conditions have caused a heavy germination of bitterweed by the end of the year, especially in Pastures K, C, A, and B. Apparently all of the other pastures have less bitterweed than we had in 1938. This is especially true in Pasture N which showed 6½% bitterweed cover in 1938 as compared with a bare trace this year. Pasture N has not been stocked since we took charge of the station.

W. H. Dameron.

Veterinary Activities

Project 242. Soremouth (Contagious Ecthyma) of Sheep and Goats. Work with this project was confined to the preparation, testing and shipment of the 608,525 doses of soremouth vaccine. Of this total 476,100 doses were sold at wholesale and 132,425 doses at retail.

I. B. Boughton and W. T. Hardy.

Project 58. Stomach Worms (Haemonchus Contortus) in Sheep and Goats. A few field immunity studies of parasite-free lambs which were placed in an infested pasture at the age of one year and the testing of *Haemonchus contortus* killing efficiency of unconditioned Phenothiazine (Thiodiphenylamine) comprised the work on this project.

In the immunity studies, three yearling lambs, which had been born and kept in clean concrete stalls during their first year of life, were turned into a known infested pasture twenty months previous to the time of this report. These animals have remained in excellent condition and occasional fecal examinations show that they are carrying only a very small *H. contortus* infestation.

Work with Phenothiazine showed that this water-insoluble drug can be suspended in water by the addition of 5% bentonite. This wetting agent is mixed with water which is then stirred gradually into the powdered

Phenothiazine. A smooth suspension, easily administered to sheep and goats with the common metal dope syringe, results.

Critical tests carried out on lambs heavily infested with *H. contortus* showed that the aqueous suspension of Phenothiazine given at the rate of .3 grams per pound of live weight killed 100% of these parasites. The drug, given at the rates of .2 gm. and .1 gm. per pound of live weight to lambs heavily infested with *H. contortus* averaged 93.47% and only 47.7% efficiency, respectively for this worm.

The aqueous suspension of Phenothiazine given at the rate of .3 gm. per pound of live weight to 79 range lambs heavily infested with *H. contortus* reduced the average fecal egg count of nine of these animals, chosen at random, from 15600 per gram to an average of 66 per gram seven days after treatment. Only after 58 days from treatment were the feces of these animals showing an appreciable amount of *Strongylus* eggs despite the fact that they were running in a heavily infested pasture.

The results of three other field tests with heavily infested lambs similarly treated and similarly examined, were entirely comparable to the test cited above.

Three heavily infested lambs, drenched with Phenothiazine, suspended in 1% aqueous solution of copper sulphate, at the rate of .1 gm. Phenothiazine per pound live weight showed fecal egg count reductions of 95.92%, 96.84% and 82% respectively.

Pen and field tests with heavily infested goats paralled the tests with infested lambs and grown sheep.

One hundred and fifty-nine head of *H. contortus* infested range Angora goats were allowed to eat, free choice in feed troughs, a mixture of one part of Phenothiazine and three parts cottonseed meal. The Phenothiazine was figured at the dosage rate of .3 gm. per pound of live weight. The animals cleaned up the mixture within one hour, some of them eating it readily and others only sparingly. Obviously the amount eaten by each animal could not be determined. Fecal samples of ten goats (chosen at random) showed an average of 1720 eggs per gram prior to treatment. One week later fecal egg counts from the same animals averaged 40 per gram.

Five parasite-free lambs placed in an *H. contortus* infested pasture and given .5 gm. Phenothiazine and 10 gms. salt daily in gelatine capsules for 139 consecutive days showed extremely small fecal egg count (made weekly) while six parasite free control lambs, running in same pasture and licking plain salt only, showed about three times as many eggs in the feces. Two of the treated lambs, autopsied at the end of the experiment, showed 304 and 5 *H. contortus* respectively while two of the control animals, autopsied at the same time, showed 823 and 379 *H. contortus* respectively.

Nineteen parasite free, weaned lambs were turned into a known *H. contortus* infested pasture and allowed to lick, free choice, a mixture of one part Phenothiazine and three parts plain salt. None of these animals showed any sign of stomach worm infestation during the 3½ months of the test and individual fecal egg counts remained at less than 200 per gram. Two of these animals, slaughtered at the end of the test, showed one and no *H. contortus* respectively. While this method gave encouraging results as regards control of *H. contortus* infestation the very noticeable staining of the fleeces of all the animals, over all parts of the body by the red dye, thionol (formed in the body from Phenothiazine and excreted in the urine) coupled with the fact that this stain cannot be scoured out, emphasizes the impracticability of this method of administration for the control of *H. contortus* infestation among range sheep.

A 4 day old lamb, drenched with 8480 live infective *H. contortus* larvae received Phenothiazine at the rate of .3 gm. per pound live weight ten days later. After 5 days (15 days from larvae administration) this animal was slaughtered and five live immature *H. contortus* were found.

The dye, thionol, is excreted in urine of the nursing lambs following the administration of Phenothiazine to the ewe.

No evidence of photosensitization following treatment with Phenothiazine and subsequent prolonged exposure to the summer sun was seen in any of the animals used in the pen and field tests.

I. B. Boughton and W. T. Hardy.

Project 314. Hard Yellow Livers of Sheep and Cattle. No new cases of this malady were found in the region where the disease appeared in epizootic proportions during 1931-32 and 1937.

Vegetation surveys conducted at various times during the period under review did not bring any additional plants under suspicion. Six animals fed *Senecio longilobus* in various stages of growth, remain under observation in pastures at this Station. Of these sheep, three were fed the weed in 1938, one in 1937 and the remaining two in 1939. At present these animals are in good condition and show no clinical signs of illness.

I. B. Boughton and W. T. Hardy.

Project 270. Swellhead in Sheep and Goats. Discontinued.

I. B. Boughton and W. T. Hardy.

Feeding Trials of Suspected Plants

Helenium microcephalum *(Sneeze Weed)* Tests showed that the leaves and stems of the mature plant are lethal for sheep in doses as small as .25% of body weight. A dosage of .125% body weight makes the animal very sick in a few hours but a similar dose, fed within 24 hours, is required for fatal results. Winter grown basal rosettes of this plant failed to produce illness when fed daily in small doses to sheep for approximately three months.

Astragalus Nuttallianus. *(Weed growing on red soil.)* Animal, fed 6.88% body weight in 4 separate feeds during 4 consecutive days, remained normal. *(Weed growing on limestone soil.)* Sheep, fed 335.04% body weight in 31 days, remained normal.

Astragalus macilentis. *(Weed growing on red soil.)* Sheep, fed 3% body weight remained normal. *(Weed growing on limestone soil.)* Sheep fed 150% body weight during 20 consecutive days, remained normal.

Stillingia treculeana. This cyanogenetic plant was fed in small doses, .25% body weight, in combination with *S. longilobus* in an effort to produce hard yellow liver disease. In each test the animal died of hydrocyanic acid poisoning after a very few doses.

Teucrium occidentale *(Western Germander).* A sheep, fed 1.12% body weight of this weed in one dose, remained normal.

Acacia berlandieri *(Guajillo).* The leaves and beans of this leguminous shrub were fed to a sheep and the leaves only to two goats (nanny and kid) in an effort to determine the cause of "limberleg" in sheep and goats. This fatal nervous condition occurs during years of extreme drouth throughout the region where *A. berlandieri* is the dominant (in some places, *only*) available range vegetation; in such years "limberleg" losses of 10% to 70% of the sheep or goat flocks on some ranges are not unusual. The largest losses occur among the adult animals.

The experimental sheep, consumed 1494.43% body weight of leaves in 291 days; during this period it also ate 83.22% body weight of ripe beans in 58 consecutive days. This animal exhibited typical symptoms of "limberleg" on the 291st day of the trial. It continues in this condition at present.

The nanny and kid have eaten 1647% and 436% body weight of leaves respectively during the past 228 days and both remain normal.

Miscellaneous

Infectious Entero-toxemia of lambs. Work during the year consisted in field trials of the immunizing value of the zinc chloride toxoid of the causative organism, *Clostridium Welchii, Type D.* A total of 2685 ewes, on seven different ranches were injected with 2 cc each of the toxoid approximately one month before lambing and 2514 pregnant ewes were left untreated as controls. The treated ewes dropped 2498 lambs of which total 11 animals (.44%) died from the disease while the control ewes dropped 2228 lambs of which 61 (2.73%) succumbed to entero-toxemia.

Infectious Keratitis of Sheep and Goats. Transmission tests, by direct smearing of ocular exudates from field cases of susceptible animals and by contact through cohabitation in same pens, were successful. Microscopic examinations of the eye exudate as well as the conjunctival cells of affected sheep and goats revealed small bodies resembling *Rickettsia.* Attempts to grow these bodies on the chorioallantoic membranes of fertile eggs were unsuccessful.

Sporadic Bovine Encephalomyelitis. Several outbreaks of this apparently new disease in range and feeder calves, all less than a year of age, were encountered during the year. We have seen this malady occasionally for the past three years and first succeeded in transmitting it to a calf in August, 1939, by subcutaneous injection of brain emulsion. The cause of the disease is not yet known.

This year the malady was transmitted to two susceptible calves by subcutaneous injection of brain emulsion from field cases. Guinea pigs were also infected by intraperitoneal injections of brain emulsions. Transmission to Guinea pigs by the intraperitoneal injection of nasal mucus from an experimental case in a calf was successful. To date we have not reproduced it by the injection of bacteria-free filtrates of brain or other tissues. In addition we have been unable to demonstrate that the urine, the blood, or the spinal fluid of typical cases is capable of transmitting the disease. Both liquid and solid media remain sterile after inoculation with blood, spleen, liver, kidney, brain, cord, spinal fluid, urine, abdominal and pleural fluid.

In field outbreaks, the course of the disease varies from ten days to three weeks while the course in the experimental calves averaged about ten days. The incubation period varies from five to twelve days in experimental cases.

Symptoms are those of an encephalitis. Gross lesions are not seen in cases slaughtered and autopsied during the first few days of the disease. Autopsy of animals dead from the malady, however, reveals a pathognomonic fibrous peritonitis and pleurisy. Microscopically, the brain and cord lesion are essentially diffuse and focal monocytic infiltrations, cuffing of the blood vessels, liquefaction necrosis and edema. Monocytic infiltration of the liver is characteristic.

The mortality averages approximately 50%. No satisfactory treatment has been found.

Laboratory. During the period under review a total of 787 specimens, experimental and diagnostic, were handled.

I. B. Boughton and W. T. Hardy.

Daily Sulphur Feeding to Lousy Calves and Goats

(Financed by Texas Gulf Sulphur Co., and done in cooperation with U. S. D. A., Bureau of Entomology, Division of Insects Affecting Man and Animals)

Two calves and six goats, all carrying a light to medium infestation of both biting and sucking lice, were given a maximum safe dose of elemental sulphur (5 gms. to 100 pounds body weight) daily in gelatine capsules during a period of ten months. The same number of calves and goats, similarly infested with lice were used as controls. There was no

evidence during the test that the sulphur has any effect on the louse population of any of the sulphur-fed animals.

O. G. Babcock and I. B. Boughton.

Calcium and Phosphorus in the Blood of Range Sheep on the Edwards Plateau of West Texas

This was the third consecutive year in which two groups of range sheep, one in Tom Green County and the other in Edwards County, and the second year in which one group of range sheep in Crockett County were bled at monthly intervals and the amounts of calcium and inorganic phosphorus in the blood serum determined. During the past year the animals in each group were fed only for a short period during January when the range was so short and dry that supplemental feeding was necessary.

None of the animals in any of these groups showed any signs of either calcium or phosphorus deficiency as judged by the monthly tests and by the lamb and wool crops. Seasonal variations in the amounts of these minerals could be rather closely correlated with the seasonal changes in the range vegetation.

One group of sheep in Val Verde County, tested at monthly intervals from February, 1938, to June, 1940, were withdrawn from the experiment at the owner's request. During the six months of 1940 in which these animals were tested there was no indication of any deficiency in either calcium or phosphorus.

Another group of 24 ewes, on a ranch a few miles west of the one mentioned above, were bled at monthly intervals, starting in July. To date no variations wider than the normal seasonal limits have been found in these two minerals in these animals.

I. B. Boughton.

Report of the Range Botanist, 1940

A final report was made on vegetation counts taken over a period of six years on ranges in Tom Green, Sutton and Edwards Counties, in which the number of plants in a meter quadrat at three or four locations at each of four ranches were counted monthly each year. At each of these four ranches the number of species of range plants each year was found to be similar, the variation being from 70 to 75; on the other hand the variation in individual numbers of plants was considerable. This variation in numbers was accounted for by a difference in the number of annual forbs and of the annual grasses. The annual forbs grow in the cooler months of the year, and more particularly under favorable moisture conditions. The perennial forbs are few in number and are not forage plants. This particular study was helpful in coming to the conclusion that density of vegetation on the range is best determined when based altogether upon the occurrence of the perennial grasses. A semi-popular article based upon these studies

was published in the July number of the magazine, THE SOUTHWESTERN SHEEP AND GOAT RAISER. ("The Herbaceous Vegetation of the Edwards Plateau.")

Also a final report was made of vegetation counts of meter quadrats located in pastures of Substation No. 14 in connection with bitterweed control studies. In one case the quadrats were located in pairs evenly distributed on both sides of the boundary fence between pastures B and G, and in the other case the quadrats were evenly distributed along the two diagonals of pasture B. These counts were made once yearly, at the time of the maturity of the bitterweed, over a period of seven years. In this period, of the total number of counts at each quadrat from 14 to 30 per cent was due to the perennial grasses, while from 15 to 63 per cent was due to bitterweed, except in those areas not adapted to the growth of that plant, and there its counts vary from zero up to 3 or 4 per cent, depending upon the occurrence of isolated spots where the habitat is suitable for its growth. Where favorable conditions exist for the growth of bitterweed in every year and in all cases it outnumbers all the other forbs taken together, and this percentage of preponderance of the forbs has increased somewhat consistently since 1931. This circumstance is to some extent due to the decrease in number of the other forbs. For the twenty quadrats along the diagonals in pasture B the number of plants of bitterweed in 1937 was 58 per cent of the number in 1931. While these counts were not made in 1939 or in 1940 it is known from counts made elsewhere that the number of bitterweed plants in these two years were more nearly approximations of the counts made in 1931. The conclusion is that wherever bitterweed is the dominant forb its variation in abundance from year to year is very closely correlated with the amount of rainfall in the fall and winter months.

Vegetation counts were made in connection with deferred grazing in two pastures at Substation No. 14, and in connection with rotation grazing in two pastures at the ranch of J. M. Vander Stucken of Sutton County, both also in relation to bitterweed control work. The vegetation counts made in two pastures of S. M. Oglesby, Jr., of Schleicher County are in connection with bitterweed control work, in which one pasture is continuously overgrazed and a smaller pasture is grazed very lightly and sporadically.

The regular vegetation counts in the fifteen pastures of the Texas Range Station were made in March, June, September and December. At the September counting 104 additional sites for making vegetation counts were established, but 2 of these were eliminated at the December counting, thus making the increase in number of sites from 95 at the beginning of the year to 197 at the close of the year.

Considerable work was done at determination of plant specimens. Some three thousand five hundred specimens were listed and numbered, and this list is being prepared as a separate and supplemental report, and not as part of an annual report. An average number of plant specimens were taken during the year.

An article entitled "Six Thistles Recently Introduced Into Texas," was published in the April number of the botanical magazine Madrono.

V. L. Cory.

Rotation Grazing in the Control of Bitterweed

Two pastures on a ranch in the southeastern part of Sutton County are used to study the effect of rotation grazing in the control of bitterweed. The west pasture is grazed in the cooler months of the year (winter-grazing) while the east pasture is grazed in the warmer months of the year (summer-grazing). The changes in grazing these pastures are made approximately at the middle of April and the middle of October. The rate of stocking is 30 units each of cattle, sheep and goats, plus 5 units of horses, or a total of 95 units. This work began in the spring of 1938, and using the counts of bitterweed at that time as 100%, the counts of bitterweed in 1939 and 1940 show the following percentages: in 1939 the west pasture showed 37.7% and the east pasture showed 83.3% of the 1938 stand, while in 1940 the percentage for the west pasture was 67.9% and for the east pasture 114.1%. We cannot say with certainty that 1938 was equally favorable with 1940 for the growth of bitterweed, but we can do so in saying that 1939 was considerably less favorable than either of the other years in this respect. The figures seem to indicate definitely that winter-grazing is effective in reducing the stand of bitterweed, whereas summer-grazing seems to favor an increase in its stand. There would seem to be a possibility that light summer-grazing combined with heavy winter-grazing might accomplish similar or even better results.

(As each pasture is grazed only half the year, the rate of stocking on a yearly basis is half of the 95 units.)

The bitterweed control work being done in the western part of Schleicher County was instituted in the fall of 1937, a year of heavy bitterweed infestation. The studies are made with fenced and unfenced quadrats in a small pasture with light and sporadic grazing and in a larger pasture with continuous and heavy grazing. There was little or no growth of bitterweed on this ranch in 1938 and 1939. In 1940 there was a medium infestation of bitterweed, and the unfenced quadrats had the infestation of the range in general whereas there were comparatively few, if any, in the fenced quadrats. Areas having spots denuded of grass continue to have a growth of bitterweed, even in the fenced quadrats.

The vegetation counts at the Texas Range Station are made by the point contact method, and this gives a markedly higher reading for density than does the quadrat method, for in the latter the number of plants are concerned rather than the amount of vegetative growth. Especially in ungrazed pastures the reading in the former method is likely to be excessively high, and, as concerns perennial grasses, indicate an increase in density at a time when the number of plants are not only not increased

but even are decreased. After three years work it appears that one may state that under conservative grazing, either continuous or regularly rotated, little or no change may be expected in the density of perennial grasses. Any seeming change in this respect is to be accounted for by a more vigorous vegetative growth under favorable growing conditions. As concerns bitterweed, the reading is higher in June than in March, whereas the number of plants are known to be less at that time. Proper allowances for the circumstances should be made when making use of these counts. In 1940 the fifteen pastures in general showed decreases in density when compared to the year of 1938, and this was due to the more favorable growing conditions of the earlier year. This decrease in density was more marked in pastures A, B, C, D and E in all of which the inclusion since 1938 of one or more counting sites having little or no grass would account for the decrease in average density. Likewise, in these cases, the average count of bitterweed would be increased out of proportion to the average count of 1938. Thus in 1940 pasture A showed an increase from 6% to 10% and pasture B from 2% to 8% in the counts of bitterweed. For the pastures as a whole the indicated increases are not actualities, but it is true that the figures for 1940 are more nearly in accordance with the facts. Except pastures A and B all the pastures in 1940 showed decreases in the counts of bitterweed as compared to the counts of 1938, and this is in accordance with the facts. In 1940 five pastures showed a stand of bitterweed in excess of one per cent, while three pastures showed a stand of less than one-half of one per cent. In stands of bitterweed these figures show that pasture A had 10%, pasture B had 8%, pasture K had 5%, pasture C had 3%, pasture G had 3%, and the pastures with minimum stands were pasture P (sheep continuously grazed) with 2/5 of one per cent, pasture F (grazed one-third of the time) with 5/16 of one per cent, and pasture N (not grazed since January, 1938) with 1/24 of one per cent, or with pasture N showing to be almost free from bitterweed. With the resumption of grazing in pasture N, which is planned to take place in March, 1941, it appears probable that the stand of bitterweed in this pasture will markedly increase over its stand at present. Future counts will show whether refraining from grazing for a period of three years is of value in the control of bitterweed. At this time the grazing of sheep during the winter months coupled with freedom from grazing, or with light grazing, during the summer months seem to offer the most aid in the control of bitterweed. Prior to making the vegetation counts in June the bitterweed was pulled and destroyed in pastures D and E, otherwise both of these pastures would have showed up in 1940 with more than one per cent stand of bitterweed. While, on the same basis in 1938, pasture D had a stand of 5% and pasture E a stand of 13%, the original location of the counting sites failed to show the actual spread of the stands of bitterweed in these two pastures. This is evidenced by the fact that for pasture D the cost of pulling the bitterweed was 79 cents an acre, whereas in pasture E the corresponding cost was $3.21 an acre. Again in 1941 bitterweed will be pulled in these two

pastures, and, at the end of 1940, the growth of bitterweed indicates that the costs in both pastures will approximate to those obtaining in 1940. Based upon this and previous work in the control of bitterweed it is concluded that it is necessary to mop-up any or all other practices for the elimination of bitterweed by carefully seeking out all growing plants of the same and destroying them, and to persist in this course of action in subsequent years as long as any of these plants are to be found on the range concerned.

W. H. Dameron.

SUBSTATION NO. 15, WESLACO

This substation is located in the Lower Rio Grande Valley near Weslaco, Texas. The station farm consists of one hundred acres of improved land, lying about midway between the cities of Weslaco and Mercedes on the main Valley highway. The four counties forming the southernmost part of the state are served by this field station. Agriculture of a highly intensified type is carried on in three of these counties, and expansion of facilities for irrigation will result in an increased demand for practical information pertaining to crop production and crop protection in this portion of the state. The annual citrus fruit crop that is normally produced in this region has a minimum delivered value of twenty million dollars, but this is only one of the sources of "wealth" that has its origin in the agricultural soils of this region.

Experiments with Citrus Fruits

Soil Management Studies: The accumulated evidence in regard to orchard practices which have a marked effect on fruit production and tree growth indicates that orchard cultivation should be reduced to the minimum, that nitrogen concentrates are most beneficial in increasing fruit production and tree growth, and that proper timing of irrigation is highly important in obtaining a good set of fruit and in sizing up the crop.

W. H. Friend.

Citrus Variety Test: Ruby grapefruit is the outstanding variety in this group, and all new grapefruit plantings should be confined to this variety. Hamlin is the most productive of all orange varieties tested at the station, but it is not the equal of Joppa Seedless in flavor or keeping quality. Of the late oranges, Texas Seedless, a bud sport of Lou Gim Gong, is sufficiently outstanding in several characteristics to be worthy of trial on a limited scale.

The commercial planting of Tangerines, Tangelos, and other Mandarin type citrus fruits is not being recommended because of the difficulties encountered in the merchandising of this kind of fruit. Mineola is an outstanding variety of tangelo that should be grown for home use and local markets.

The freeze of January, 1940, served to remind Valley citrus growers that lime and lemon properties must be adequately protected with orchard heaters. Cold resistant lemons of the Meyer variety produced a crop in 1940 that has been estimated as being 35% of normal.

W. H. Friend.

Fertilizer Tests: In a twelve year old grapefruit orchard, trees which received seven pounds of sulphate of ammonia per tree per year for the past three years outyielded and outgrew trees which received 5-15-5 at the rate of twenty pounds per tree per year. This is the fourth test of this nature to show the outstanding importance of nitrogen in citrus fruit production.

W. H. Friend.

Wound Protectants: Studies to determine the efficiency of the cheaper types of tree wound dressings were continued. When more than ten per cent of tung oil was added to the asphaltum-carbolineum mixtures, the adhesiveness of the wound paint was lowered. Repainting with the cheaper asphaltum-carbolineum is more desirable than using the more expensive, longer lasting dressings containing tung oil. The efficiency of asphalt emulsion dressings was increased by using four per cent lysol solution (liquor cresolis comp.) as a thinner in the place of water.

W. H. Friend.

Tree Injection Studies: A simple and inexpensive method of making injections of soluble chemicals into the vascular system of trees was developed. A modification of the "bore hole" method, in which three foot lengths of ⅝ inch garden hose were used as the injecting apparatus, was used in these studies. The materials used included chemicals such as zinc, copper, and iron salts for the correction of nutritional disease and fungicides such as zinc chloride and copper sulfate for the control of heart rot decay.

W. H. Friend.

Citrus Breeding: Interspecific and intervarietal crosses were made involving several kinds and varieties of citrus. The following crosses were successful: Hamlin orange crossed with Joppa orange and Valencia orange crossed with Hamlin orange. Seedlings representing 12 crosses made in previous seasons are now growing in station nurseries.

J. F. Wood.

Citrus Orchard Heating: Large capacity oil heaters were placed on approximately 450 acres of orchard containing grapefruit, oranges, and lemons on the property of Engelman Gardens, Inc. Temperature records were made at several locations, both within and outside of the heated areas. The temperature remained 26° F. and below for more than 10 hours with a heavy frost formation. When outside temperatures were 24° F. and 25° F., the temperatures within the heated blocks were from 28° to 30° F. Continued cold, cloudy weather following the hard freeze lessened

the damage to unprotected citrus trees materially. In most cases, only a small percentage of the foliage was lost and very few branches were killed back.

J. F. Wood.

Citrus Diseases

Citrus chlorosis: In a continuation of citrus chlorosis control studies, grapefruit and orange trees about 50 per cent chlorotic in one large badly affected orchard were brought to practically complete recovery by soil applications of zinc sulfate with and without sulfur, with the factor of greater permanence in favor of the former. Sulfur and sulfur compost alone or in combination with other mineral salts did not improve the plants. In this case the disease was clearly zinc deficiency chlorosis.

G. H. Godfrey and Herbert Rich.

Citrus gummosis: Studies involving some hundreds of inoculations, made during the summer, disclosed that there are at least 4 different types of gummosis occurring in the Lower Rio Grande Valley: (1) Physiological, short in duration, and not particularly injurious; (2) *Diplodia natalensis* gummosis, a mild form in which the weakly parasitic organism is checked in its invasion of the wood by the laying down by the host tree of a hard resinous layer; (3) an active foaming type caused by sap fermenting organisms, definitely infectious and transmissible, but not penetrating deeper than the cambium layer and not spreading extensively; (4) an internal wood-rot gummosis caused by an undetermined, actively parasitic sapwood invading fungus, spreading in long, broad streaks into the wood of the trunk and branches, and showing a characteristic pink color at the advancing margin. Type 2 was readily controlled by removing protruding wood to hasten healing-over of the wound, and the application of a wound-coating material. Type 3 was quickly and permanently stopped by cutting the bark to expose the discolored cambium, then applying a surface disinfectant and a coating material. Type 4, much more difficult to control in advanced cases, and by far the most abundant and most serious form, was the subject of a demonstration test 2½ years ago. All discolored wood was chiseled out, together with a safety margin ¼ inch beyond, and a penetrating disinfectant (carbolineum) was applied, followed by an adhesive surface coating agent (50-50 asphaltum-carbolineum plus 2 per cent phenol). In November this tree showed no further gumming, healing was well under way, and the tree was healthy in appearance. An adjoining tree that had received only surface treatments was actively gumming, several branches were dead, and the tree obviously doomed.

G. H. Godfrey.

Citrus Insects

Toxicity Tests of Atomized Oils on Scale Insects: A high degree of control of Florida Red scale on citrus was secured with undiluted atomized oil sprays. No injuries were secured by any of the materials used.

Atomized materials consisting of 5 grams of Derris resins (25% rotenone) dissolved in 100 cc. of K-58 (2 (4 tertiary-butylphenoxy) ethanol) gave a low degree of control when applied in a high state of atomization in the following oils: heavy mineral oil; heavy mineral oil (3 parts)-kerosene (1 part); light mineral oil; light mineral oil (3 parts)-kerosene (1 part).

P. T. Riherd.

Population Studies of Rust Mites, *Phyllocoptes oleivorus*, and Texas Citrus Mite, *Anychus clarki*: The peak of the Rust mite population was reached during the second week of April. This peak agreed with the 1939 infestation, but there was a heavy infestation that occurred in September, 1939, that did not occur in 1940. The peak of the Texas citrus mite population occurred during the last week of August.

P. T. Riherd.

Control of Scale Insect Crawlers: The results of tests to control scale insects in the crawler stage were negative. Three applications of the following dusts were applied: Pyretoxide-Sulphur (10-90); Rotessone-Sulphur (10-90); 3% organic Nicotine Tobacco dust-Sulphur (25-75), and Sulphur.

P. T. Riherd.

Experiments with Subtropical Fruits

Variety Adaptability Studies with Dates: There are now 196 established palms of 25 varieties in the station garden. Of this number, 76 are from Iraq, 2 from Arizona, and the remainder from California.

The following varieties are represented in the station collection: Maktoom, Halawy, Thoory, Zahidi, Saidy, Safraia, Dubaini, Hayany, Deglet Noor, Tazizoot, Okht Fteemy, Khadrawy, Sukkar Nabat, Kustawy, Tadala, Amir Haj, Khatuni, Jaffary, Bedraya, Khasab, Sayer, Ashrasi, Bahrab, Dayri, and Braim.

J. F. Wood.

Propagation and Fruiting of Date Palms: Eighty-three date palm offshoots were removed and sent to the Winter Haven Station. Seventeen varieties were included in this shipment.

One hundred and ten fruit bunches were borne on palms of 13 varieties in 1940. Amir Haj and Halawy dates ripened in a fairly satisfactory manner on the palms. Some fruit was ripened artificially with heat, and it was found that the best method is to remove the individual fruits from the stems rather than to leave them as an entire bunch. Artificially matured Halawy fruit was of better quality than that of the other varieties.

J. F. Wood.

Tests to Repel Insects from Date Palm Fruits: A series of sprays were applied to date bunches in an attempt to find some material that would

repel the insects and to determine if the material affected the maturity of the fruit. No repellency to wasp and ant was obtained.

P. T. Riherd.

Papaya Breeding: First generation seedlings involving crosses between the Bronson, Graham, Betty, Florida, and Orlando strains of papayas are being grown. These crosses were made in an attempt to obtain large fruited types of good quality. These seedlings have been sib-pollinated and back-crossed to each parent. Seedlings of a large fruited variety received from Colombia, South America, are being grown and will be used to produce pollinated seed. These improved varieties are being used in the establishment of commercial plantings of papayas in the Valley.

J. F. Wood, W. H. Friend.

Papaya Fruiting Studies: Small papaya plants were treated with various dilutions of ethylene chlorohydrin, ethylene dichloride, potassium thiocyanate, and ethylene gas in an attempt to induce early fruiting. No appreciable difference could be observed in time of fruiting caused by these treatments.

Papaya plants just coming into bearing were injected with 2 cc. of ethylene chlorohydrin solutions of various strengths. Readings were taken at the end of two months, which indicated that injection of 2 cc. of the 75% material increased fruit setting.

J. F. Wood.

Papaya root rot and wilt: In commercial and home garden plantings of papaya a serious root rot appearing usually about the time of first fruit formation in early fall and continuing through the fall and winter, has been found to be due to a species of Pythium not yet identified. The disease begins with a rot of small roots which spreads to the large fleshy roots and thence to the crown of the plant, when complete collapse occurs following a sudden wilting. Cultural and inoculation studies are under way.

Herbert Rich.

Avocado Rootstock Tests: A nursery of West Indian seedlings was established this year, and a collection of cold resistant scion material was assembled. Development of a highly successful method of propagation appears to be the principal need of the avocado industry in the Valley, and work along this line is being conducted.

W. H. Friend.

Banana Root Disease: Failing banana plants on the Station grounds were found to be heavily infested in their root systems by a lesion-producing nematode, *Rotylenchus multicinctus*. One bunch of Cavendish bananas whose roots were extremely heavily infested, died.

G. H. Godfrey.

Pecans: Plants which remained alive throughout the year made very satisfactory growth, but one-fourth of the trees died from root rot disease

during the first season. New plantings were made on sterilized plots of soil, and soil injections of root rot inhibiting chemicals will be used in an effort to control the disease.

W. H. Friend.

Experiments with Other Fruit Crops

Grapes: Few varieties of grapes will set fruit regularly in this region because the winters are too mild to cause dormancy. Early pruning and banking are being used in an effort to keep the vines dormant for at least two months.

W. H. Friend.

Strawberry Adaptability Tests: Tests to determine the adaptability of new varieties developed by the Winter Haven Station in comparison with standard varieties were continued in 1940. Narcissa and Texas 34 were the first varieties to produce ripe fruit in December from September planted runners.

Studies to determine the effectiveness of root stimulating substances in enabling the plants to recover quickly from transplanting shock were continued this year.

W. H. Friend.

Experiments with Vegetable Crops

The vegetable industry is becoming increasingly important in the Lower Rio Grande Valley. Corporate farming is on the increase, as vegetable producing and distributing firms from other states have moved to the Valley to take advantage of the cheap labor, cheap water, and the fertile soil resources of this region.

Most of the station work with vegetables is confined to a few of the major crops, as it is not possible to do field work with all crops during a single season.

Cabbage Variety Tests: Midseason Market and Enkhuizen continue to outyield all other varieties, but some of the recently developed "yellows" resistant strains offer considerable promise. Varieties such as All Head Select and Marion Market are worthy of extensive trial, just as soon as reliable commercial stocks are available. Of the small headed varieties, Round Dutch and Resistant Detroit are the outstanding varieties. The production of late (February and March) cabbage is becoming increasingly popular. Varieties of the Ball Head or Hollander type are the most popular late varieties because of the ability of these types to withstand severe cold weather and also because these tight heading varieties are damaged less by insect pests.

W. H. Friend.

Cabbage Variety Tests in Cameron County: Sixteen varieties and strains of cabbage were grown near Harlingen and near Los Fresnos during the

winter of 1939-40. Of the early varieties, Resistant Detroit and Round Dutch deserve special mention. Both of these varieties produced more than 50% of their tonnage at the first cutting, which was made only 78 days after transplanting. Resistant Detroit is the more desirable type for market, being medium sized, round, and very compact. Of the mid-season varieties, Glory of Enkhuizen ranks first from a market desirability standpoint as well as being a high yielding sort. Hollander and Danish Ballhead were outstanding for the late varieties. Danish Ballhead produced the higher yield.

J. F. Wood.

Cabbage Fertilizer Test: Mixtures which supply both nitrogen and phosphoric acid give the best results with cabbage. Four hundred pounds per acre of a mixture composed of equal parts of 11-48-0 and cotton seed meal (7% N) gave exceptionally good results during the fall season of 1940. The 11-48-0 ammonium phosphate applied as a side dressing, at the rate of three hundred pounds per acre, also gave outstanding results on land having a fairly high nitrogen content.

W. H. Friend.

Cabbage Fertilizer Tests in Cameron County: These tests were conducted near Harlingen and Los Fresnos. The treatments consisted of three sources of nitrogen (Cyanamid, sulfate of ammonia, and calcium nitrate), an 8-16-8 fertilizer with and without an organic base, and an 8-16-0 fertilizer with and without minor elements. Glory of Enkhuizen was the variety used. The yields were greater on the plats which received the larger amounts of nitrogen, regardless of source. The fertilized cabbage, however, had a tendency to be large and coarse which made it less desirable from a marketing standpoint than that from the unfertilized plats. The check plats produced 15 tons per acre without fertilizer. The use of smaller sized varieties and moderate amounts of nitrogen fertilizer is indicated for these soils.

J. F. Wood.

Cabbage Black Rot: Several seed treatment tests were non-productive of results in black rot control because even the check lots did not produce black rot. The standard bichloride treatment invariably reduced germination, in some cases as much as 30 per cent. Several other treatments with penetrating disinfectants did not reduce germination. Determination of their efficacy for black rot control awaits further tests with reliable infected seed.

G. H. Godfrey.

Control of Cabbage Worms: Derris-Sulphur (10-90) gave the best control of the cabbage looper and the diamond back on cabbage. A proprietary mixture of calcium arsenate and Paris green; Calcium arsenate alone; and Paris green-Lime ($7\frac{1}{2}$-$92\frac{1}{2}$) were also used in the test.

P. T. Riherd.

Cabbage Freezing Injury: Repeated observations on market plants showed that serious freezing injury occurred on recently set plants at the time of the January freeze when a minimum temperature of 23° F. was reached. Symptoms were: whitish mottling in tender leaves and leaf stalks; hollow regions in the stems below the growing point; failure to produce marketable heads. Shippers reported injury from the November freeze (minimum 28°). Heads received were loose, light in weight, and unacceptable.

G. H. Godfrey.

Crucifer Breeding Test: A large number of cabbage, collards, and broccoli selections are being tested as well as crosses of cabbage and collards. This breeding work is being done at the main station, College Station; the field tests and selection are being done at Substation No. 15. Individual plant measurements were taken as well as comparative yields.

J. F. Wood and W. S. Flory.

Tomato Variety Test: The late January freeze delayed the 1940 tomato season by almost thirty days. This gave the extra early varieties like Break O' Day and Valiant even more advantage than they normally have over late types such as Rutgers and Marglobe that must set most of their crop after hot weather has set in for the summer. (April first).

In the fall planting, late varieties such as Marglobe and Pearson made a very favorable showing, as fruit setting took place during the cool short days of November.

W. H. Friend.

Tomato Variety Tests in Cameron County: Nine varieties of tomatoes were grown near Harlingen and near Brownsville. Considerable difficulty was experienced in growing tomatoes this season due to a January freeze which destroyed the first plantings and continued cold weather which interfered with the normal development of the second planting. Stokesdale, Pearson, and Valiant set more fruit under the adverse weather conditions than the other varieties; while Marglobe and Pritchard were most adversely affected. Rutgers and Stokesdale were the two most desirable varieties for market. Valiant and Pearson are newer sorts which show promise for this section.

J. F. Wood.

Tomato Transplanting Studies: In an effort to secure early fruiting of transplanted tomato plants, sixteen different treatments were applied to the plants used in these tests. In most cases, transplanting solutions of various kinds were applied about the roots at the time the plants were set in the field, but in some cases, the materials were applied in holes about the roots of field seeded plants. Some of the treatments gave slight increases in yield of early fruit, but the most outstanding results were secured from a form of girdling that apparently brought about a favorable nitrogen : carbohydrate balance for fruit setting.

W. H. Friend.

Tomato Fertilizer Tests in Cameron County: Sulphate of ammonia alone, 32% acid superphosphate, 8-16-8 with and without an organic base, and an 8-16-0 with and without minor elements were the treatments used. Tests were conducted near Harlingen, Los Fresnos, and Brownsville. The Rutgers variety was used at Harlingen and Brownsville, and Break O' Day was used at Los Fresnos. No valid conclusions could be made due to the poor growing conditions which overshadowed any effects the fertilizer might have had. The Break O' Day test yielded almost twice as much fruit as either of the Rutgers tests.

J. F. Wood.

Tomato Breeding: Back-crosses of four Texas hybrids were made with their parental or grandparental types. Individual plant selections were made in a field of William's Globe, a local variety. Plant selections for hardiness were made in populations of Break O' Day and Rutgers following an early fall frost.

J. F. Wood.

Tomato Soil Amendment Studies: Seventeen replicated treatments of various fertilizers and minor elements were made in 8 in. tile pots. One pruned and staked tomato plant was grown in each pot. Weights of individual fruits were taken and weights of each plant were recorded at the close of the test. Indications were that some of the minor elements such as magnesium might be used advantageously in connection with the fertilizer program for tomatoes grown on this soil.

J. F. Wood.

Tomato Fruiting Studies: A study of the fruiting response of tomatoes to pistil treatment with various concentrations of naphthalene acetic acid, Vitamin B_1, magnesium sulphate, and a commercial hormone dust was made. This experiment was conducted in the field during hot weather and no fruit set on any of the emasculated flowers on the checks or on any of the treated plants.

J. F. Wood.

Tomato Tip Blight: No further spread of this virus disease occurred on a Donna farm showing 2 to 11 per cent disease in random counted rows, after rogueing out all diseased plants.

G. H. Godfrey.

Tomato Fruit Worm: An extremely high population of *Heliothis armigera* occurred in early March on young corn and tomato foliage, but natural conditions had begun to reduce the number of worms by the time the plants had begun to set fruit.

P. T. Riherd.

Potato Variety Tests: Chippewa and Katahdin potatoes, planted as late as February 10th, gave yields of marketable tubers well over two hundred bushels per acre. This is much better performance than can be expected from Triumph potatoes planted at the most favorable season, which is

before the normal frost danger period is past. The Chippewa potato has been adopted by Valley growers, and carload lots of seed will be planted during the 1941 season. Twenty-eight varieties including several new varieties such as Sequoia, Sebago, Pontiac, and Earlaine were included in the adaptability tests during the fall season. Cold stored seed potatoes, which were harvested in April, gave much better stands than seed grown in more northern latitudes which was harvested in June or July and held in common storage until planting time.

W. H. Friend.

Potato Fertilizer Tests: Plats of land which had previously received annual applications of 6-18-0 fertilizer at the rate of 400 pounds per acre produced the highest yields of marketable tubers, but fertilizers were ineffective on land which produced sorghum in 1939. The series of fertilizer plats which grew a crop of sweet sorghum in 1939 produced about 25 bushels per acre less than comparable plats which grew tomatoes during that year. However, the small sized tubers produced on the sorghum stubble were much superior to the others for seed purposes. Since whole seed is used for the fall crop, a high percentage of size 2 potatoes is very desirable where the crop is to be used as seed stock.

W. H. Friend.

Potato Fertilizer Tests in Cameron County: These tests were conducted near Los Fresnos and Brownsville. Bliss Triumph was the variety used. The Los Fresnos test consisted of 40 treatments with an unfertilized check. One purpose of this test was to determine the toxic limits of various fertilizer materials. The highest yield was obtained from an application of 400 pounds of 32% superphosphate. There was a tendency for the yield to be lower as the amounts of fertilizer increased on practically all treatments. A sharp drop in yield accompanied a 1000-pound application of Cyanamid, a 1500-pound application of sulfate of ammonia, and a 500-pound application of Urea. These applications are equal to 210 pounds of actual nitrogen per acre for Cyanamid and Urea and 300 pounds per acre for the sulfate of ammonia.

The Brownsville test consisted of six fertilizer treatments and an unfertilized check. The yields were satisfactory in all cases. The highest yielding treatment was 8-16-0, and the lowest was superphosphate 32%. There was considerable variation between plats receiving the same treatment in different blocks which must have been due principally to an uneven soil moisture condition; hence the reliability of the resuits is questionable.

J. F. Wood.

Potato Strain Test in Cameron County: Nineteen strains of the Bliss Triumph variety from various seed producers of North Dakota were used in this test near Brownsville. There was considerable variation in yield between the different strains. The lowest yield was 80 bushels of No. 1's

per acre, and the highest yield was 148 bushels of No. 1's per acre. In general, the medium and medium early strains produced more than the early strains.

J. F. Wood.

Green Manuring Studies: On the soil improvement plats, potatoes and cabbage follow sweet clover, crotalaria, sesgania, tomatoes, sweet corn, and Sudan grass. Soil condition was much better on the plats that previously grew legumes, and the potatoes made the greatest top growth on the clover plats. However, there was no marked difference in the appearance of the cabbage or potato plants on the other plats in this test.

W. H. Friend.

Potato psyllid Yellows: Airplane dusting with sulfur over large areas, under frequent observation in the Los Fresnos section ,apparently gave good control of psyllid yellows. In adjoining non-dusted fields typical symptoms were severe. Comparative yields were around 200 bushels per acre in dusted fields as against 60 to 80 bushels in non-dusted.

G. H. Godfrey.

Potato Late Blight: The complete freedom of potatoes from late blight *(Phytophthora infestans)* in the Lower Rio Grande Valley was apparently due to the continued dry weather during the sprouting and early growth periods. This season therefore contributed importantly to the theory that the need or lack of need for spraying for late blight can be predicted on the basis of the early season weather. The application of this theory has important economic potentialities in this section. On its basis, projected spraying tests were not conducted.

G. H. Godfrey and Herbert Rich.

Potato Scab: An extensive sulfur application experiment for scab control on a field with a history of serious scab in previous years was nonproductive of results. In common with the rest of the Valley, scab incidence was very light in the experimental field, with an average of less than one scab lesion per tuber in the check plots. Scab is distinctly seasonal in its occurrence in this section.

G. H. Godfrey and Herbert Rich.

Sweet Potato Variety: Ten starch varieties and two table varieties were used in a test designed to test the adaptability of this crop to Valley conditions. One series of plats was located on land which had a crop of Sunn Hemp *(Crotalaria juncea)* incorporated with the soil, while the other series was located on land that had a crop of Sudan grass incorporated during the fall season of 1939. The Sudan treatment gave the highest yield of potatoes (16 tons per acre for the Triumph variety), but the Crotalaria plats produced the largest roots. Since the previous use of the land and its organic matter content have an important bearing on the control of root rot, nematodes and weevils, the performance of sweet

potatoes on Sudan sod was especially encouraging. Early plowed, well fertilized sod land gives the best results obtainable with a number of crops produced in this region.

Of the table varieties, Louisiana Unit 1 produced yields as high as 12 tons per acre, and the roots were of exceptionally good table quality.

W. H. Friend.

Lima Bean and Snap Bean Varieties for Canning and Quick-Freezing: Six varieties of lima beans were grown in the spring of 1940. These beans were both canned and quick-frozen, using dry pack and brine. Henderson's Bush, Baby Potato, Lima, and Baby Fordhook Lima produced high yields of small tender beans highly desirable for this type of product.

Six varieties of bush snap beans and three varieties of pole snap beans were grown during the fall of 1940. Plentiful, Tendergreen, and Full Measure matured two weeks before the other sorts. Detailed notes were taken on vine and pod characteristics. The beans were packed as a canned cooked product and as a quick-frozen uncooked product. The Blue Lake pole varieties are promising both from the standpoint of quality and yield. There was very little difference in the quality or yield of the bush varieties studied.

J. F. Wood.

Sweet Corn Varieties for Canning and Quick-Freezing: Twenty-two varieties of sweet corn were grown in the spring of 1940. Notes were taken on earworm infestation, days to maturity, ear measurements, and yields. In general, the yellow varieties were of better quality than the white varieties. The corn was quick-frozen both on the cob and as cut corn. The quality of Iogold A, Ioglen, and Ioana was especially good.

J. F. Wood.

Sweet Corn Hybrid Adaptability Test: Sixteen Texas hybrid sweet corns were tested in comparison with Ioana, a commercial hybrid sort. Ioana is a cross between Purdue 39 and Iowa 45. Each of the 16 Texas hybrids also had Iowa 45 as one of its parents. Of the sixteen lots, three were equally as good as Ioana in quality and produced more than double the yield of Ioana. The main reason for these yield differences was due to corn earworm damage. All ears damaged beyond the tip were considered unmarketable in this test. On the basis of this classification, approximately 50% of the Ioana ears were discarded whereas only 10 to 17 per cent of the ears of the three Texas hybrids were unmarketable.

J. F. Wood.

Breeding and Improvement: Sixty-eight strains of inbred yellow Tuxpan corn were grown on the station during the spring of 1940. Forty of these strains were inbred during the spring and planted again in the fall. Although the fall crop was severely damaged in an early frost, it is believed

that between 30 and 40 strains inbred for the third time (during the fall season), can be salvaged. Each of these lines is to be used as one parent in top-cross and single cross hybrids in the spring of 1941.

J. F. Wood.

Corn Earworm Control: Corn earworm infestation was reduced in Stowell's Evergreen Hybrid, Country Gentleman, and Country Gentleman Hybrid 19 x 24 by the applications of a mixture of 75% mineral oil plus 25% pyrethrum household spray applied to the tips of the ears just after pollination had occurred.

P. T. Riherd.

Control of Onion Thrip: In a field test, replicated eight times, three applications of crude Naphthalene-Flour Sulphur (25-75) increased the yields of onions 6.66%; crude Naphthalene-Calcium carbonate (80-20) increased the yields 23.05%; 3% organic Nicotine Tobacco dust-Sulphur (50-50) increased the yields 26.40%; while crude Naphthalene-Cyanamid (25-75) reduced the yields 35.5%; Cyanamid spread over the surface of the soil reduced the yields 41.5%. The above percentages are based on yield data comparisons on the untreated check.

P. T. Riherd.

Cantaloupe Breeding and Selection Studies: This test was inaugurated in an attempt to obtain a cantaloupe resistant to downy mildew. Twenty-six lots of seed were received from the U. S. D. A. at LaJolla, California; one lot from the U. S. D. A. at Charleston, South Carolina, and one lot from the University of Florida at Gainesville. Ten hills of each lot were planted. No readings on resistance could be obtained this season because of the complete absence of downy mildew. This is the first season in several years that no infection has occurred. Seeds were saved, however, from open pollinated fruits from several selections. The fruits were selected as to size and quality.

J. F. Wood.

Miscellaneous Insect Investigations

Control of the Garden Fleahopper, *Halticus citri:* Nine combinations of Rotenone and Pyrethrum bearing dusts were tested against this insect at Donna, Texas. These dusts consisted of ground Pyrethrum flowers and ground Derris root as well as some of the newer types of Pyrethrum and Rotenone bearing materials. These experiments indicated that Rotenone is ineffective in controlling the garden fleahopper. Pyrethrum gave much the best control.

Tests were also conducted at Rangerville, and these included the newer forms of Rotenone and Pyrethrum dust. These Pyrethrum and Rotenone proprietaries are commercially prepared from extracts of the toxic materials. Naphthalene, Nicotine dust, and ground Pyrethrum flowers plus 7% Paris green were also used. Sulphur was used as a diluent in all of the

dusts. The same general results were secured in these tests as were secured in previous tests. The Rotenone and Nicotine were less toxic than Pyrethrum. No control was secured with Naphthalene. Paris green, added to Pyrethrum dust, increased the control of this pest.

P. T. Riherd.

Control of the Harlequin Bug and False Chinch Bug: A 1% spray consisting of a saturated solution of refined naphthalene in miscible oil was found to be highly toxic to the Harlequin cabbage bug and to the False Chinch bug.

P. T. Riherd.

Control of the Harvester Ant, *Pogononyrnex barbatus:* The results of these experiments indicated that carbon bisulphide and water applied in the depression at the entrance to the nest is the most practical method of controlling Harvester ants. However, the eradication of harvester ants on a large scale may be accompanied successfully and economically by the use of methyl bromide applied in soil auger holes with a tube injector. No control was secured by surrounding the entrance to the nest with rotenone bearing dust. Nests surrounded with sodium fluoride were weakened for some time but later regained their strength.

P. T. Riherd.

Experiments with Agronomic Crops

The expansion of the Valley's livestock industry, and the soil improvement program which is being sponsored by the A. A. A. have increased the demand for information pertaining to agronomic crops. There is a continued interest in flax, soybeans, cereal grasses, and winter legumes which might be used for forage purposes.

Cotton Variety Tests: Eighteen varieties of cotton were grown on the station test plats; while six long staple varieties were grown at each of the three locations selected for regional tests, on heavier types of soil. Delta and Pine Land 11A and Stoneville 2B ranked either first or second in each of the four tests. D. and P. L. ranked first in three of these tests and was second in the fourth test. These early maturing, high yielding, long staple varieties seem to give good results under a wide variety of conditions. In one regional test, conducted on the best cotton soil in the Valley, four of the six varieties produced more than two bales of lint per acre; while the best variety produced slightly less than 1500 pounds of lint cotton per acre that had a staple length of 1 1/16 inches.

W. H. Friend.

Cotton Irrigation Tests: Supplemental irrigation applied to the soil after the crop was planted (when the first bolls were half grown) failed to increase yields this season. This may be accounted for by the fact that

there was an abundance of rain during June, and there was also a good reserve of subsoil moisture left over from the copiously irrigated winter vegetable crop.

W. H. Friend.

Corn Adaptability Tests: No variety tests were conducted on the station farm, but observations made on a cooperative test of hybrid corns indicate that certain inbreds might be of value in developing hybrid seed corn involving our better adapted field varieties. This line of work will be expanded during the 1941 season, using inbred lines of Tuxpan which have been inbred and reselected for two spring and fall seasons. Tuxpan is unquestionably the most productive ensilage and grain variety, and the large ears are well protected by heavy tight fitting shucks. Hybridization should enable this single eared variety to produce larger sized, well covered ears under conditions of thick stand.

W. H. Friend.

Sudan x Sorghum Adaptability Tests: Since leaf streak disease (rust) is one of the principal objections to Sudan grass as a temporary pasture or for dehydration purposes, an effort is being made to develop disease resistant types. Seed for these tests was supplied by Mr. R. E. Karper, who developed these Sudan x sorghum crosses. There was a marked difference in disease resistance between strains, and the taxonomic characters varied from those approaching true Sudan grass to strains showing a predominance of the sorghum genes. Some of these resistant strains will be worthy of extensive trial just as soon as the stocks are sufficiently well stabilized to be released for commercial seed production purposes.

W. H. Friend.

Teosinte: This tropical forage crop, which is really a cross between corn and the grass tripsicum, produced abundant yields of leafy forage and succulent sweet stems under Valley conditions. Since the plants stool out readily, a small quantity of seed will plant a considerable acreage.

W. H. Friend.

Soybean Variety Tests: Previous tests have shown that soybeans produce better yields of beans during the short, cool days of the long fall season. Unfortunately, the fall season of 1940 was not as long as usual, and a temperature of 28 degrees on November 15th caused considerable damage. The best yield from the 36-inch spacing between rows was obtained from the most cold resistant variety No. 60247 (13.2 bushels per acre), but several of the early maturing varieties such as Illini, Manchu, and Dunfield produced comparable yields. Since these trials were conducted under very unfavorable conditions, it is felt that the fall production of soybeans may offer greater promise than these tests would indicate.

W. H. Friend.

Flax Variety Tests: One hundred and seventy-six strains and varieties of flax were included in the adaptability tests with this crop. For the

second year in succession, Bolley's Golden was the high yielding variety (28.9 bu. per acre.). Punjab, Giza, Argentine, and several of the new varieties derived from Giza and Rio produced equally good yields. Punjab is the most popular early variety, while Rio is a favored late type that produces considerably more straw and is more resistant to rust than Punjab.

W. H. Friend.

Cereal Grasses: One hundred thirty-two varieties of wheat, forty-four varieties of oats, and forty-four varieties of barley were grown in station nurseries this season. Yields of wheat varied from nothing to thirty-two bushels per acre, and there was almost that much difference in the amount of damage from stem and leaf rust. South American varieties made the best showing.

Oat varieties varied considerably in their ability to withstand rust, some varieties retaining their bright green color as late as April first. Yields varied from nothing to seventy-five bushels per acre. Oats are not considered to be a grain crop in this region, but strains which retain their green color late in the season would be useful for dehydration, or for use as pasture crops.

Some of the barley varieties produced surprisingly good yields (80 bu. per acre) and some of the giant beardless barley strains were exceptionally good forage varieties.

Much of the success attained with cereal grasses during the 1939-40 season must be attributed to unusual drouthy conditions which prevailed during the fall and winter seasons and to favorable rains during the time the grain was maturing (March). During a normal season, fall rains would likely result in more serious damage from leaf and stem diseases.

W. H. Friend, E. S. McFadden.

Castor-bean Variety Tests: The three varieties, which produced the highest yields in 1939, again topped the list. U. S. No. 7, because of its more desirable plant characteristics, must be considered superior to the slightly higher yielding flowering type (Red Top) which yielded 1200 pounds of shelled beans last season. Because of the expense involved in growing and harvesting the crop, higher yielding, non-shattering varieties must be developed before castor-bean production will be profitable on agricultural lands of this region.

W. H. Friend.

Experiments With Ornamental Plants

A number of plants having ornamental value were added to the station collection during the 1940 season. Of the new specimen plants added to the collection of native plants are *Amyris madarensis, Phaulothamnus spinescens, Mimosa fragrans, Xylosma celastrus,* and two species of *Lycium.* The outstanding addition to the vine collection was a specimen of *Petrea*

volubilis. A specimen of *Quercus agrifolia* was added to the collection of oak trees, but this holly leafed oak appears to be well adapted to Valley conditions. A number of new varieties of hibiscus were acquired during the year including several strains of yellow and orange flowered varieties.

Rootstock Tests with Roses: Thirteen understocks budded to the Talisman and Caledonia varieties were included in this replicated test to determine the effect of various rootstocks on plant survival, plant vigor, and blossom production. Stocks such as Welch and Irish showed the highest mortality rate while stocks such as Ragged Robin and Texas Wax produced the fewest blossoms. Odorata understock occupied an intermediate position as to blossom production but showed a higher mortality rate than the Multiflora hybrids. The best of these, Multiflora x blands, produced five times as many blossoms per plant as did the poorer understocks such as Ragged Robin.

W. H. Friend, J. C. Ratseck.

Rose chlorosis: Practically complete control of severe chlorosis was brought about in 5 rose gardens by carefully placed soil applications of acid sulfur compost and iron shavings. In one outstanding test with some plants 90 per cent chlorotic, none of the plants so treated died. In a comparable non-treated area of the same bed, 16 of the original 31 plants died, and there was practically no change in the chlorosis status in the balance.

Herbert Rich and G. H. Godfrey.

Aphids and Mealybug Control: Good control of aphids and Mealybugs on hibiscus was secured with an application of Pyretoxide-Sulphur dust (10-90).

P. T. Riherd.

Acid Sulfur Composts for Quick Soil Acidification: A continuation on a large scale of the sulfur compost studies has indicated that where quick effectiveness in soil acidification is desired, an initially acid sulfur compost is superior to straight sulfur. In a series of soil treatments it was 8 months before a high-sulfur application "caught up" with the sulfur compost of equivalent sulfur content in amount of acid developed.

G. H. Godfrey and Herbert Rich.

High-Sulfur vs. Low-Sulfur Composts: Acid auto-acidifying composts of both high and low sulfur content were developed in the course of a few weeks incubation. Approximately equal low pH's were obtained in both extremes. In general, however, because of the low absorbing power of granular sulfur, total acidities were higher in a relatively low-sulfur mixture containing absorptive organic matter as the filler. Representative readings were as follows:

High-sulfur compost (90-12),	**pH 0.41; total acidity 3.09 per cent**
A 50-50 mixture	**pH 0.44; total acidity 7.36 per cent**

A sulfur compost and soil mixture, 25-75, containing only 12½ per cent sulfur at the start attained pH 0.91 in a little over 3 months, with a total

acid content of 2.60 per cent. Such a material, low in cost because of low sulfur content, could be applied at a high rate to a single-season crop with which temporary acidification of the soil might be desirable. A 90-10 or 80-20 mixture, with high sulfur content, would be applicable to perennial plants where prolonged acidification is desirable.

G. H. Godfrey and Herbert Rich.

Varied Sulfur Compost Mixes: A wide range of types of organic inert materials were used in preparing a series of composts, with approximately equal results throughout. Among the materials used were barnyard manure, powdered charred dehydrated citrus peel, screened leaf mold from the forest, goat manure, and milled cottonseed hulls. Both coarse (16 mesh and finer) ground sulfur, and the very fine grades were used in mixtures without any great difference in rate of development of acid. In general, the "16 and finer" grade has been adopted for the making of composts for field application. The very fine dusting sulfurs can, of course, be used when they are the available form.

G. H. Godfrey and Herbert Rich.

Acid Sulfur Compost vs. Aluminum Sulfate for Soil Acidification: A comparison was made between a sulfur compost and aluminum sulfate in the effect of leaching on retained acidity. The aluminum sulfate and soil mixture (rate of application, 5 tons per acre foot) rose from an initial pH of 4.05 to 7.39 after leaching; then dropped to 7.00 in 17 days, and a month later was 7.42. The sulfur compost, initially at 1.62 rose to 3.65 after leaching with distilled water, then dropped to 1.05 in 17 days and to 0.99 two weeks later. The aluminum sulfate would not appear to be as effective a material as the auto-acidifying sulfur compost where prolonged acidification is desired.

G. H. Godfrey and Herbert Rich.

Soil Sterilization by Fumigation: Beginning in May, 1940, several lots of nematode infested soil inoculated also with *Sclerotium rolfsii* were subjected to fumigation treatments in 2 cubic foot capacity sealed drums. Ethylene dichloride and carbon bisulfide applied at rates corresponding to 4000 pounds per acre-foot of soil completely eradicated both organisms. At 2000 pounds, a trace of the fungus (a single sclerotium) was left alive and the nematodes were killed. The tests are being continued to determine minimum lethal dosages.

G. H. Godfrey.

SUBSTATION NO. 16, IOWA PARK

Texas Substation No. 16 is located in the Wichita Irrigated Valley, 2½ miles southeast of Iowa Park, and 10 miles west of Wichita Falls, in Wichita County, Texas. The latitude is 33 degrees and 55 minutes north; longitude 98 degrees and 39 minutes west; elevation 974 feet above sea level.

The average annual rainfall at the substation is 30.53 inches for the 15-year period, 1926 to 1940, inclusive.

The station comprises approximately 161 acres of land, of which approximately 90 acres are devoted to crops under irrigation and 71 acres are in river bottom and creek bottom pastures and waste lands. The soil types on the station are of the Miller and Yahole series and are fairly typical of the soils of the irrigated valley as a whole. The station was established in the fall of 1924 for the purpose of conducting agricultural research and experimental work with all crops that may be grown under irrigation in this part of the state. Irrigation water is furnished the station from Lake Kemp and Lake Diversion through canals of Wichita County Water Improvement District No. 2. A free and perpetual water right was given the station by the Irrigation District at the time the Station was established. The work at this Station is directly concerned with the general improvement of agricultural crops and farming conditions in the Valley. It includes varietal studies of all field crops, vegetables, fruit crops and ornamental crops. Crop rotations, duty of irrigation water, fertilizers, rates of plantings, dates of plantings, cultural practices, diseases and insects and their control as well as many other minor projects are included in the experimental program of this Station. Breeding and feeding of sheep is being given attention, particularly as a means of utilizing and marketing feeds which are grown so abundantly in the irrigated valley.

Cotton

Variety Test: Yields of cotton were above the average this season. Of the twenty-five varieties included in this test the ten highest yielding ones with their yields in pounds of lint cotton per acre are as follows: D.P.L.11A, 694; Hi Bred, 659; Stoneville 5A, 653; Delfos 531B, 641; Ferguson 406, 607; Lentz Acala, 605; Rogers Acala, and Texas Special, 594; Western Prolific, 586; and New Boykin, 585. It is interesting to note from this list that in the highest yielding five or ten varieties one can choose almost any type of cotton desired.

Spacing Test: Mebane 140 was the variety used in this test and the spacings were 3, 6, 9, 12, 18, 24, 30, 36, and 42 inches. Yields in this test were below the average for other cotton tests this season due to a long-time cropping program on this field of cotton and grain sorghum without any soil improvement practice. As usual the closer spacings made the higher yields with a rapid drop in spacings wider than 18 inches. The 6-inch spacing gave the largest yield of 418 pounds of lint per acre.

Dates of Planting: Mebane 140 was the variety used in this test and the planting dates were April 18, May 1, May 16, June 3, July 2, and July 17. Yields of the earlier plantings were outstandingly large this year compared to later plantings. The April 18 planting made the highest yield of 676 pounds of lint per acre. May 1 was second with 613 pounds per acre, and May 16 was third with 575 pounds per acre. In only 4 years out of 10 has

the earliest date produced the most lint but in three of these years the difference was so marked that the average for the 10 years shows this date to be leading by a margin of 21 pounds per acre over the next highest yielding date of May 15.

Duty of Water: The object of this test is to determine the optimum amount of water required to produce the maximum amount of cotton. Both rainfall and supplemental irrigation water are considered. Due to ample rainfall early in the season no pre-irrigation was necessary, and only two supplemental irrigations were required in late summer. The highest yield of 598 pounds per acre was made by plats receiving only 4 acre inches of irrigation water which was applied in two light irrigations of 2 inches each. Heavier irrigations resulted in decreased yields. Plats receiving no irrigation water made an average of only 239 pounds of lint per acre which is only 40% of the yield made with the addition of the two light irrigations. The rainfall for the growing season was 20.89 inches and no doubt would have been ample for maximum production had it been properly distributed.

Grain Sorghums

Variety Test: Of the 15 varieties of grain sorghum grown in comparison with corn, the five leading varieties from the standpoint of yields in bushels of threshed grain per acre were: Chiltex, 51.3; Spur Feterita, 48.8; Ajax, 40.4; Kalo, 39.9; and Early Hegari, 35.6. Golden June corn yielded 21.7 bushels per acre, which, incidentally, is unusually large for corn in this valley.

Variety and Spacing Test: In this test with Dwarf Feterita, Hegari, and Texas Blackhul Kafir, the spacings were 3, 6, 12, 18, and 24 inches. The 6-inch spacing produced the highest yield for each of the three varieties as follows: Hegari, 33.1 bushels; Texas Blackhul, 29.4 bushels; and Dwarf Feterita 29.5 bushels. The range in yields between the different spacings in all varieties was small with the lowest yield from any variety or spacing being 25.2 bushels per acre.

Duty of Water Test: Both rainfall and supplemental irrigation were considered in this test. Spur Feterita was the variety used. Rainfall was ample early in the season so no pre-irrigation was necessary. Only two supplemental irrigations were applied late in the season. These were apparently not necessary as the dry-land plats produced the highest yield of 31.6 bushels per acre. The lowest yield of 21.8 bushels was made by plats receiving next to the highest amount of irrigation water which was applied in two irrigations of 5 acre inches each. Over a nine-year period the dry-land plats have an average of 16.3 bushels per acre less than the best irrigation series.

Hegari Strains Test: Five strains of Hegari planted on 3 different dates as follows: April 17, June 1, and July 18. The strains included were Early, Lubbock, Chillicothe, Woodward, and Arizona. Although the differences in

yields were not so great between varieties, the differences in yields between dates of planting were quite marked. Yields from all varieties in the second date of planting averaged 25% higher than yields from the first date of planting, and yields from all varieties in the third date of planting averaged 20% higher than from the second date of planting. The highest yield from any variety and any date of planting was 54.1 bushels of threshed grain per acre from Early Hegari in the last planting.

Double Cropping with Early Grain Sorghums: Quadroon and Sooner Milo were the varieties used in this test, and April 15 and June 15 were the planting dates. Quadroon made 47% greater yields than Sooner Milo in the first planting and 19% greater in the last planting. These percentages were based on the averages of four harvest treatments. Quadroon made a second or sucker crop ranging from 7 to 16 bushels per acre on the first planting but was too late for a sucker crop on the last planting. Sooner Milo failed to make a second crop on either planting. The best total yields from the first planting were Quadroon with 38.8 bushels per acre and Sooner Milo with 21.8 bushels per acre. The best yields from the last planting were Quadroon with 46.2 bushels per acre and Sooner Milo with 35.7 bushels per acre.

Rate Test: This test included four varieties, Early Hegari, Sooner Milo, Double Dwarf Milo, and Quadroon, planted in 18-inch and 36-inch spacings. In all four varieties the 18-inch spacing made the largest yields ranging from 54.4 bushels for Quadroon to 37.7 bushels for Double Dwarf Milo. Quadroon showed the greatest range between the 18-inch and 36-inch spacings with a difference in yield of 16 bushels per acre in favor of the 18-inch spacing. For the other three varieties the difference in favor of the 18-inch spacing averaged about 5 bushels per acre.

Small Grain

Wheat Variety Test: Five varieties were included in this test with yields in threshed grain per acre as follows: Chiefkan, 26.3 bushels; Tenmarq, 25.0 bushels; Oro x Tenmarq, 22.7 bushels; Clark's Blackhul, 22.0 bushels; and Early Blackhul, 21.9 bushels.

Oats Variety Test: Oats were damaged by severe winter freezes and yields were poor in all varieties. The five varieties included in this test with their yields in bushels of threshed grain per acre were as follows: Texas Red Rustproof, 51.2; New Nortex, 48.0; Ferguson, 46.6, Fultex, 42.2, and Frazier, 31.4.

Barley Variety Test: Barley, like oats, suffered from winter injury and yields were light. The five varieties included in the test with their yields in bushels per acre were as follows: Tennessee Winter, 29.0; Harlan Hybrid No. 1-33-7, 28.6; Finley, 25.4; Wintex and Harlan Hybrid No. 1-33-179, 24.7 each.

Crop Rotation Studies

This test includes studies on continuous cropping, 2-year rotations, 3-year rotations, and 4-year rotations with cotton, grain sorghum, oats and alfalfa. The highest yield of cotton was 786 pounds of lint per acre and was made on a 3-year rotation of cotton, oats, and alfalfa. The highest yield of grain sorghum (Feterita) was 58.3 bushels of threshed grain per acre and was made on a 4-year rotation of feterita, cotton and 2-year alfalfa. The highest yield of oats was 77.6 bushels per acre and was made on continuous cropping plats where summer fallow was practiced following oats harvest. There was very little difference in yields of alfalfa where grown in continuous cropping, in rotation with cotton and oats, or in rotation with cotton and grain sorghum.

Castor Bean Variety Test

Eight varieties of castor beans have been grown for a period of two years with annual average yields of threshed seed per acre as follows: U. S. D. A. No. 7, 1386 pounds; Flowering, 1318 pounds; Kolp, 1296 pounds; U. S. D. A. No. 4, 1195 pounds; Conner, 1190 pounds; Wagner, 1116 pounds; Brazilian, 775 pounds, and Common, 260 pounds.

L. E. Brooks.

Lamb Feeding Experiment

This project included 100 Rambouillet wether lambs which were fed 84 days to provide a market for farm grown feeds and to demonstrate that fine wool feeder lambs can be fattened on these common feeds. The feeding trial involved two main comparisons, (a) alfalfa hay (Lots 1 and 2), vs. sudan hay (lots 3 and 4), and (b) ground quadroon heads (lots 1 and 3) vs. chopped quadroon heads (lots 2 and 4).

In each instance lots fed alfalfa made more gain and finish but this difference was more marked where chopped heads were fed than where ground heads were fed.

Ground heads produced appreciably more gain and finish than chopped heads, only when fed with sudan hay. Limestone supplement was used with the sudan hay and twice as much cottonseed meal was used as for the lots fed alfalfa hay.

J. M. Jones, J. H. Jones, and L. E. Brooks.

Fruit Adaptability Studies

The two major problems limiting fruit production in the Wichita Valley are climate and cotton root-rot *(Phymatotrichum omnivorum)*. The purpose of the adaptability studies is to find kinds and varieties of fruit which are resistant to the disease and adaptable to the climate.

The year 1940 was one of the best fruit years in the past five years. All fruit crops on the station produced fruit of excellent quality and in good amounts.

Peaches: Fourteen years of variety test work with 76 varieties of peaches has shown that several are fairly satisfactory and may be expected to produce fair to good crops most years. In order of their ripening dates they are as follows: Mayflower, Alexander, Early Wheeler, Carman, Dr. Burton, Belle of Georgia, J. H. Hale, Frank and Salwey. Two peaches in the young test orchards which show considerable promise are Halehaven and Hart Cling.

Plums: Forty-six varieties of plums have been tried out in the past 14 years. None of them was wholly satisfactory. Plums with native blood have been best. Five of the most satisfactory varieties are Sapa, Opata, America, Gold and Waneta.

Apricots: The apricot is fine for the home orchard and has some value as an ornamental shade tree. Its early blooming habit frequently results in the loss of the crop, however. The best variety on which a long record is avalable is Moorpark. Superb shows considerable promise. The crop on both varieties was excellent this year.

Nectarines: Only one, Flaming Gold fruited this year. The crop was about normal. The quality of this variety is mediocre.

Grapes and Berries: For the first time in three years there was a light crop of grapes. The best variety from the standpoint of yield was Thompson Seedless.

Blackberries and Dewberries produced a light crop of fruit. Station soils have not proved very satisfactory for these fruits. The best dewberry is the Austin, and the best blackberry is the Dallas.

Cultural Experiments with Peaches

An experiment has been set up to find some means of adding organic matter to the soil without endangering the trees. Green manure crops for orchards in this area probably should not be such that they can carry or spread cotton root-rot. For this reason oats was chosen as the winter crop and sudan as the summer crop. With such crops it appears necessary to add additional nitrogen to prevent their decay from reducing the available fertility of the soil, as well as to maintain the nitrogen level during the growth of the green manure crops. Barnyard manure was chosen as the source of added nitrogen, partly for the sake of the nitrogen, and partly because it also adds organic matter. At the end of the first year of treatment no conclusions can be drawn from the growth or fruiting records. There is a possibility that the use of a summer green manure crop may have somewhat retarded growth but it is still uncertain.

Strawberry Soil Treatment Tests

After three fruiting years the plats have completely changed their ranking from the standpoint of yield. Plats treated with 1 ton of lime per acre ranked third in 1939 but they rank first in 1940. Plats receiving 600 pounds

of sulfur per acre ranked last in 1939 but in 1940 they rank second. The first ranking plats in 1939 which received 20,000 pounds of manure and 2,000 pounds of lime ranked sixth this year. The plats which received 80,000 pounds of manure previously ranked second. This year there were practically no plants in these plats. Stands on all manure treated plats were much reduced during the summer of 1939.

Vegetables

A somewhat different procedure was following in the vegetable variety trials this year. Rather than running a few varieties of a number of kinds of vegetables two kinds were chosen, and many varieties of each planted. Each variety was planted four times in randomized blocks so that there were four replications of each variety in the experiment.

Beets: The results indicate that beets of the Crosby type were generally superior to the Detroit Dark Red types. The best beet in the experiment from the standpoint of yield was Early Red Chief. Early Red Chief ranked second to Boston Crosby as a market beet.

Lettuce: Fifteen varieties of heading lettuce were tried. Although the season was probably the most favorable in many years for heading lettuce very few varieties made enough heads to warrant further trial. The best variety, and the only one which headed 100 per cent was Imperial No. 44. The heads were of only fair quality.

Seven varieties and strains of leaf lettuce were tried. Any of the Grand Rapids type would be rated as best in this group. Probably Grand Rapids U. S. No. 1 was a little the best quality.

Miscellaneous Vegetable Trials: Several varieties of snap beans, lima beans, edible soy beans, and sweet grain sorghum were planted out for observational trial this year. The edible soy bean is certainly worth further trial. None of the sweet grain sorghum varieties seemed to carry sufficient sweetness.

Fall Crops: Due to severe insect damage no fall crops of vegetables were made this year at the station.

Cultural Tests With Vegetables

A series of tests to determine the effect of manures, the method of watering and the use of inorganic fertilizers on vegetable crops were set up.

Crops which did best with flood irrigation are beans, cabbage, and onions. Crops which did best with rill irrigation are Swiss chard, leaf lettuce, English peas, carrots and cucumbers. The method of irrigation did not seem to affect beets or radishes.

Cabbage, carrots and onions were no better on manured than on unmanured plats, but all other crops produced considerably more on the manured plats.

Inorganic fertilizers neither increased nor decreased yields.

Straw as a Source of Organic Matter

This experiment was set up to determine whether or not it would be possible to use straw in combination with additional nitrogen as a source of organic matter. The supplies of manure in this area are limited. Beets were used as the indicator crop. Results in 1939-40 were as follows: In general the yield of beets increased with amount of nitrogen applied. The addition of straw increased crop yields in every case when applied with nitrogen over the increase obtained from the use of nitrogen alone. Straw was applied at the rates of 4,000 pounds, 8,000 pounds, and 16,000 pounds per acre. Ammonium sulfate was applied at the rates of 500 pounds, and 1,000 pounds per acre.

Shade Trees and Ornamentals

Two plants should be mentioned as valuable additions to ornamental plantings. The first of these is *Adina rubella*. The leaves of this plant are small, dark green and glossy. The flower clusters are a handsome light purple and persist for a long period in the fall. It is very attractive and could be used for foundation plantings or in groups of small plants. *Pyracantha lalandii* is the second. It is a fine semi-evergreen rather slow growing, but eventually attaining considerable size. Its persistent coral red berries remain through the winter. The shrub does well in full sunlight.

B. S. Pickett.

Root Rot Studies

Crude Oil Treatment on Cotton Land: This test included five treatments as follows: (1) 705 gallons of oil per acre, (2) 1410 gallons per acre, (3) 4231 gallons per acre, (4) 7052 gallons per acre, (5) 9873 gallons per acre and (6) no treatment check. A final count at the end of the growing season showed the following percentages of dead plants per treatment: (1), 78; (2), 74; (3), 63; (4), 41; (5), 46, and (6), 62.

Yields in pounds of lint per acre per treatment were as follows: (1), 722; (2), 660; (3), 575; (4), 551; (5), 503, and (6), 605.

Sorghum as a Root Rot Remover: A field which was known to be severely infested with the root rot fungus pryor to the beginning of the test has been planted to Redtop cane continuously for a period of 7 years, and will continue to be planted to a nonsusceptible grass crop for an indefinite number of years to determine whether the fungus can be killed out by this method.

L. E. Brooks.

Grape Resistance Studies: Various grape root stocks which have shown a marked resistance to root rot in other localities have been tested over a period of years beginning in 1934. Champanel, Lomanto, Lukfata, Black Spanish, Dogridge, La Pryor, Mustang, Cleota, Candicans, Ladano, *Vitis*

champani, V. cinera, and *V. rupestris* are used in the trials. So far, while none of them has proved completely immune, all of them have shown some resistance.

Apple Resistance Studies: Three years ago 50 plants of Ames 550 (Brier Sweet x Mercer County Crab) were set out on land known to be infected with root rot. Seventeen of the original 50 survive, only one of which was definitely known to have died of root rot. Most of the others were killed by mechanical injury the first year they were set out. Of the seventeen remaining January 16, 1941, all but one was in excellent physical condition. All but two of the plants were dug for inspection. It was found that in all but two cases the roots were injured by root rot. Nevertheless the root systems were in good condition. Fourteen of the trees were set out in an orchard for further study.

B. S. Pickett.

SUBSTATION 19, WINTER HAVEN

Substation 19 is located in Dimmit County, between Carrizo Springs and Crystal City, in the center of a large area specializing in the production of vegetables with irrigation. The substation is located on fine sandy loam (mostly Webb and Crystal series) with about 100 acres in cultivation. Irrigation water is supplied by pumping from underground sources.

The year 1940 was mostly favorable for crops with a total rainfall of 21.94 inches. A killing frost in the fall on November 15 severely damaged tomatoes, peppers and other fall crops. Temperatures were below normal in every month of the year except December. As a result some fruits like grapes and dates ripened later than usual. A severe hailstorm occurred on April 6 that injured plums and citrus considerably. Good crops of strawberries, onions and corn were obtained. Citrus crop was fair in spite of hail damage.

The program consists of studies with vegetables, fruits and other irrigated crops and also includes breeding work with onions, spinach, cantaloupes, tomatoes and strawberries. Disease and insect control are important studies.

Fruits

Adaptability: The following varieties bore satisfactory crops in 1940: San Jacinto apple; Toyahvale apricot; Belle, Frank, Pallas, Smith and PI-61302 peaches; Douglas and LeConte pears; Burbank, Excelsior, Jacob and Munson plums.

Citrus Varieties: Best yields over a period of years from eight-year old trees or younger have been with Kawano, Owari, Silverhill, Miyasaki, Sueoka and Yakushiji satsumas. All of these satsumas are good commercial varieties. Some difficulty was experienced with fruit molds during damp weather.

The high yielding orange varieties are Joppa, Hamlin and Louisiana Sweet. The best commercial varieties in 1940 were Hamlin and Joppa.

Swatow and Clementine tangerines gave good yields of marketable fruit. Best tangelos in the 1940 season were 52018T2A and 52018K12G both unnamed selections of superior flavor.

Citrus Rootstocks: High seed yields were obtained from Carrizo citrange, citrumelo, Kansu orange, Chinotti orange, Swatow tangerine, Changsha tangerine.

Satsumas budded in 1932 show the following combinations to be outstanding so far: Ikiriki on Savage citrange, Kawano on 15137 and Cunningham citranges, Morita on Cunningham citrange, Owari on trifoliata and Carrizo citrange, Silverhill on Cunningham and 15137 citrange and trifoliata.

Oranges budded in 1933 are showing very little differences on various stocks in Texas Navel and Hamlin combinations but Joppa is greatly dwarfed on trifoliata stock and is yielding best on Rusk citrange. Washington Navel is giving good yields of fruit on trifoliata stock.

Swatow tangerine is yielding equally well on trifoliata and Rusk citrange. Clementine tangerine is better on 15137 citrange than on trifoliata.

Marsh Pink grapefruit has thinner rind and more desirable fruit on citrumelo stock than on sour orange.

Date Varieties: Good yields were secured this year but ripening was delayed from three to four weeks because of unusually cool weather. In curing tests Amir Hadj and Braim were outstanding. For dessert quality (fresh), Hayany, S-13, and Kustawy were good. A seedless variety, S-15, failed to ripen because of insufficient heat. Additional plantings of 11 varieties not previously grown were received from the Weslaco substation in May. This makes a total of 28 named varieties in our test.

Grape Varieties: In 1940, yields were mostly about normal. Champanel, Alicante Bouschet, Black Muscat, Grenache, Black Malvoise, Black Spanish, Chasselas Fontainebleau, Armalaga and Extra were good yielders. For dessert and table grapes, Kandahar, Sultanina (Thompson Seedless) and Black Muscat are good.

Grape Rootstocks: Yield records so far indicate the following to be good combinations: Alicante Bouschet on Dog Ridge, Black Muscat on Dog Ridge, Black Malvoise on Champanel, Chasselas Fontainebleau on Champanel, Armalaga on LaPryor. The Thompson Seedless variety seems to be doing well on LaPryor and T. S. 22354 *(V. candicans)* stock.

Strawberry Varieties and Breeding: Strawberries began bearing in December and were delayed by the freeze January 19. Season yields showed Ranger, T34 and Missionary to be outstanding in yield.

In five years of records Alamo and Ranger varieties have outyielded Missionary and Klondike.

In the breeding tests, some promising selections were made in Ranger crosses with Alamo, Riogrande, and T10.

Ornamentals

The low of 19° F. in January injured some of the more tender ornamental species. Outstanding during 1940 tests were: *Baeckia platycephala, Cordia boissieri, Eucalyptus crucis, Pyracantha rogersiana,* and *Xylosma flexuosa.*

E. Mortensen.

Field Crops

Corn Varieties: Hybrid corns outyielded open pollinated varieties in 1940.

Cotton Varieties: Cotton varieties were tested at El Indio in Maverick County and Stoneville 2B and Delfos 4729 definitely outyielded 5 strains of Acala under irrigation. Boll weevils were especially bad and only one picking was made in spite of which Stoneville 2B yielded 718 lbs. lint per acre.

Sorghum Varieties: Sorghum varieties were tested at Quemado in Maverick County with 65 bushels of grain per acre for Texas milo. Hegari was the most desirable forage variety.

Flax Varieties: Flax varieties were protected from bug damage by sulfur dust in 1940. Yields above 30 bushels per acre were obtained from several selections. Newland, Giza and Punjab gave good yields.

E. Mortensen, C. Riecker.

Vegetables

Variety Descriptions (In cooperation with the Bureau of Plant Industry, U. S. Department of Agriculture): The object of this work has been to obtain definite descriptions of ideal types of the more widely used vegetable varieties. In the fall of 1940 the fourth crop of peppers and eggplants was grown, the first having been grown in 1937. In the pepper trial there were 17 varieties, and in the eggplant test there were 6 varieties. Considerable emphasis was given to detailed descriptions. In general the season was fairly favorable to this project and considerable progress was made in collecting the type of descriptive material desired.

Adaptability Studies: During the year, the following numbers of varieties and strains of vegetables were included in the trials: Sweet corn 31, tomatoes 26, and watermelons 21. The Iogold strains of sweet corn mentioned in last year's report were again grown. No. P39I45 has been renamed and is now known in the trade as Ioana, P51I45 has the name Ioglen. The performance of these strains again justified previous reports to the effect that these varieties have considerable promise for south Texas.

Included with Ioana and Ioglen were a number of yellow sweet corn hybrids developed at the main station. Several of these appeared even more promising than the two varieties mentioned, but it will probably be a year or two before any of these are ready for release.

Among the tomatoes, Stokesdale was again outstanding as a high yielding variety suitable for shipping. In shape and thickness of wall the fruit closely resembles Marglobe, and yet the plant has the high productivity of Bonny Best. More growers would do well to try Stokesdale. Such varieties as Marglobe, Rutgers, and Pritchard failed to yield as well as Stokesdale and none of them had as high a percentage of marketable fruit.

The chief trial of watermelon varieties was conducted at Derby, Texas, in the watermelon section. A smaller test of a few of the more important varieties was planted at the station at Winter Haven. Florida Giant was among the most promising of the varieties tested, being large, productive, and having a fine interior color. Most of the Tom Watson strains yielded well, but quality was usually off some. Clara Lee or Black Diamond resembled Florida Giant in shape, size, and color of fruit and yielded about as well as that variety.

Fertilizing Onions in seedbed. Onions receiving fertilizer in the seedbed did not yield any more at harvest time than those left unfertilized. Both lots were fertilized alike after being transplanted from the seedbed. This result differs from that of last year when the onions receiving fertilizer in the seedbed outyielded those without fertilizer. This year the seedbed was more fertile to begin with, and this may explain the lack of difference. The experiment will be repeated in future years.

Comparison of Dry Sets with Green Plants. Through the cooperation of Dr. J. P. McCollum of the Illinois Experiment Station some dry sets of Yellow Bermuda onions were grown in the North, and then green sets or plants of the same lot of seed were grown at Winter Haven. The dry sets were planted at three different times: about three weeks before the normal onion transplanting time, at the normal time, and about two weeks after the normal time. Green plants set out at the normal time exceeded all plantings of dry sets in yield of U. S. No. 1 onions. All fields of Bermuda onions had many premature seedstems (bolters) in them, but in this experiment the early planted dry sets had extremely high percentages of them. Further work on this project is necessary before final conclusions can be drawn.

Time of planting onions. A comparison was made between early planted onions and those planted at the normal time. The three varieties, Early Grano, Babosa, and Yellow Bermuda were used. Seed of all three varieties was sown September 8 and again September 18. Plants were transplanted to their field locations November 9 and 23 respectively. Early planted Yellow Bermuda onions produced a crop of which 90 per cent were seedstems, and the yield of U. S. No. 1 onions only 14 bushels per acre. Normal

planted Bermudas produced 95 bushels per acre, and 61% of the total yield was seedstems. In contrast to this both Babosa and Early Grano produced larger U. S. No. 1 yields in the first planting than they did in the second. Seedstems were very few in the first planting, negligible in the second. As an example of yields, Babosa produced 329 bushels of U. S. No. 1 onions in first planting, 293 bushels in second. Based on this one season's experience it would seem as though the Babosa and Early Grano varieties can be sown about two weeks earlier than Yellow Bermuda.

Time of Harvesting Onions. Plats of Yellow Bermuda and Early Grano onions were harvested at three different times, each about three weeks apart. The first was at the time when the tops were beginning to fall over, the second when 40 to 50 per cent of them were down, and the last when 80 to 90 per cent or more were over. Yields in bushels of U. S. No. 1 onions per acre for Yellow Bermuda at the three successive harvestings were: 60, 105, and 148. For Early Grano the corresponding figures were: 271, 389, and 487. This experiment requires further study in future years, but the data so far suggest that early harvesting is probably not profitable unless the price received is very high.

Tomato Culture. Studies on seedbed handling are being continued, but unexpected troubles with ants in the seedbed upset the treatments in 1940.

Tomato Breeding. Considerable seed of Summerset was produced in the spring and again in the fall and has been released to the seed trade so that this new variety will now be available from a commercial source. Summerset is a heat resistant variety which bears fruit in the Winter Garden Region and similar localities during July, August, and September when the temperature is high and the relative humidity usually low.

The first generation progenies of crosses between Summerset and Bison were tested this year and some very promising selections made. One of these was backcrossed to Summerset, and also crossed with Stokesdale. Because of the success with Summerset, it is hoped that at some future date an even larger fruited variety adapted to the summer can be obtained.

Onion Breeding. Work in this project is still continuing slowly, but through the initiation of a cooperative project with the Bureau of Plant Industry of the United States Department of Agriculture may proceed somewhat more rapidly in the future. A large number of plats of onions were set out in the fall as a result of this new cooperation. The crossing and selection work in the original project was of course continued.

Leslie R. Hawthorn.

Plant Diseases

Breeding spinach for disease resistance. The work has been continued on the control of the three most important diseases of spinach in the Winter Garden area, namely, downy mildew or blue mold *(Peronospora spinacee)*, curly top (virus), and white rust *(Albugo occidentalis)*. Em-

phasis has been placed on the development of disease resistant varieties but fungicidal treatments were also tried.

Selections for resistance to downy mildew made two years ago have been carried through another season. Some of the progeny plants are in very good growing condition and have shown relatively little damage from downy mildew in comparison to the check plants.

In the absence of severe natural infection artificial epidemic of curly top was attempted by confining several thousand viruliferous beet leaf hoppers *(Eutettix tenellus)*, the virus vector, in a ¼-acre spinach planting for the purpose of discovering disease resistant plants, if such should be present. By the end of December more than 25 per cent of the plants in the enclosure were destroyed by curly top and the indications were that many more plants were coming down with the disease. The surviving plants should produce seed by April or early May.

Selections for resistance to white rust are being made from a wide area of commercially grown spinach which has been very badly hit by this disease. It is becoming more and more apparent that white rust may prove to be the most devastating disease on spinach in the Winter Garden and may seriously threaten the existance of the industry in this area. The disease showed in severe degree earlier than usual this fall and has already developed to such an extent that many hundreds of acres have been left uncut on account of it. Every advantage is being taken of the unprecedented epidemic this season (1940-1941) in order to discover disease resistant plants.

Secondary spread of white rust has been found to be accomplished by flooding which is the method of irrigating the broadcast-planted spinach in this area. Circumstantial evidence suggests wind dissemination of the fungus spores from diseased fields to non-infected fields for a distance of at least several miles. The disease has been found also in abundance in fields where no spinach had been grown before. The incubation period of the disease is about 12 days at an average temperature of about 70° F. and relative air humidity of about 80%.

The white sporangia of the fungus may germinate in free water in less than 24 hours at about 70° F. and release swarmspores which are capable of germinating in a few hours at room temperature. A search is being made in the Winter Garden area for *Blitum capitatum* which is a host to the species of white rust fungus attacking spinach.

Breeding Onions for Resistance to the Pink Root Disease (Phoma terristris)

Breeding for resistance to this consistently destructive disease on field onions in South Texas has been carried up to the second year of inbreeding of selected onion bulbs. The resistance of the inbred lines have been tested by (1) growing seedlings in artificially infested soil, by (2) growing onion transplants in naturally infested soil until mature bulb have been

formed, and (3) by growing the mature bulbs in naturally infested soil until production of seed. The most distinct differentiation between degrees of resistance has been obtained by growing seedlings in artificially infested soil.

As a result of one and a half generations of inbreeding, testing, and selecting, a few lines have been secured which, apparently because of their resistance, have appreciably outyielded the commercial Bermuda onions, when grown on pinkroot-infested land. The inbreds are of the Yellow Bermuda and Crystal Wax types but lately some selections have also been made of the Grano (or Babosa) type of onion which is becoming increasingly popular with the growers.

Inbreeding on the whole has reduced the vigor of the open pollinated onions but it has been found that by selection some inbred individuals can be secured which in vigor compare favorably to the average open pollinated commercial onion.

Incidentally, it has been found that the Grano onion under local conditions is considerably more susceptible to the pink-root disease than the Bermuda onion and consequently the planting of this variety on pink-root infested land should be avoided.

In regard to selfing onion plants, satisfactory results were obtained by bagging individual umbels with cellophane bags with or without blow flies placed in them.

Breeding Cantaloupes for Resistance to Downy Mildew and Other Troubles

The breeding of commercial cantaloupes for resistance to downy mildew *(Pseudoperonospora cubensis)* has been advanced through three additional generations during the year and further selections, inbreeding, and backcrossings were made for resistance to downy mildew and aphids. The most severe test for resistance to the mildew was made in the third planting of the season in late fall when a severe epidemic of the disease appeared. Many of the 100 or so lines under test were wiped out completely while others were badly damaged. A few lines were only slightly affected. Data were also obtained on the relative susceptibility of the different strains to diseases other than downy mildew, such as powdery mildew, Fusarium wilt, southern blight and mosaic.

Studies on non-infectious chlorosis. Non-infectious chlorosis is common on some vegetable and feed crops and many ornamentals in the Winter Garden. Studies were started to find the causes of the condition and find remedies.

Cowpeas were selected as the test crop in all trials made thus far because of several advantages. This crop is very susceptible to chlorosis when grown on heavy calcarious river land, but has a good green color on light sandy land. From a practical standpoint growing cowpeas on

the river soils in the hot summer season, when few other crops could profitably be grown, would help to build up the soil and keep down the weeds.

Four crops of cowpeas (mostly var. Brabham) were grown in greenhouse benches in different soils and with different soil treatments, as follows: river soil with heavy application of sulfur; river soil with medium application of sulfur; river soil with no sulfur added, and light sandy soil with no sulfur added. Records were taken, two months after planting on the average of about 50 plants, as follows: on the degree of chlorosis, on the average height and weight of the plants, and on the amount of root nodule formation. Records were also taken on the N acid basicity and on the changes of the pH of the soils. The results thus far have shown that addition of sulfur to the soil corrects to some degree the chlorotic condition of the plants. The plants grown in such soils grew taller and were heavier. The addition of sulfur also resulted directly or indirectly in larger root nodule formation. The average weight of the nodule tissue of plants grown in sulfur treated river soil was several times that of the plants grown in same soil without the sulfur. The check plants grown in the light sandy soil had the greenest color of all, and produced the largest amount of nodule tissue, but were smaller and lighter in weight, probably because of low general fertility.

The average pH of all soils, treated and untreated, at the beginning of the trials was about 8.0 or higher, and underwent no significant change during all trials. The N acid basicity of the river soils varied from 41 to 44, while that of the sandy soil was about 0.8.

Attempts were made to correct the chlorotic condition of the plants by spraying them with various salt solutions (0.5%), including iron sulphate, magnesium sulphate, manganese sulphate and zinc sulphate, but the results were negative. Spraying the plants with a suspension of "Mike" sulfur did not change the chlorotic condition.

S. S. Ivanoff.

Report of the Entomologist

Tomato fruitworm. Control experiments were started late in the season after a large number of eggs was first observed October 14. One dust application resulted in approximately 50 per cent reduction in numbers of damaged fruits on the plat where calcium arsenate or on the plot where a mixture of cryolite 70 parts and sulphur 30 parts was used. A dust composed of cube and sulphur containing approximately 0.75 per cent rotenone was ineffective in reducing the tomato fruitworm damage.

Onion thrips. This pest was more destructive than usual over South Texas. The Early Grano and Babosa varieties withstood the heavy thrips infestations better than the Crystal Wax or Yellow Bermuda. Two dust materials containing nicotine and a mixture of naphthalene and sulphur failed to give satisfactory control of the onion thrips when applied late in the season after the population was high.

S. E. Jones.

SUBSTATION NO. 20, STEPHENVILLE

The 46th Legislature made an appropriation for the establishment and maintenance of an agricultural experiment station in the West-Cross Timbers Region of Texas, which appropriation became available September 1, 1939. A tract comprising 618.85 acres of land near Stephenville, Erath County, was donated by the citizens of that area and accepted as a site for this experiment station to serve the West-Cross Timbers Region. Approval of title was secured and possession of the land was had near the close of the fiscal year of 1940. Thus the work accomplished during the fiscal year reported upon here consists largely of repairing buildings, fencing, and getting the land in readiness for experimental work designed to serve the Region.

COOPERATION

Memoranda of agreement providing for cooperative research have been entered into or continued during the year with the following bureaus of the United States Department of Agriculture:

Bureau of Agricultural Economics:

1. A study of agricultural adjustment in Texas;
2. Cotton fiber and spinning research (also with the Bureau of Plant Industry and the Texas Engineering Experiment Station);
3. A study to determine the economic and social effects on farms resulting from the operation of a definitely planned program of soil conservation;
4. An estimate of the farm population and farm population movements;
5. The accuracy of small samples for wool shrinkage and grading determinations;
6. A study of Texas farm leasing arrangements in relation to the conservation of agricultural resources.

Bureau of Animal Industry:

1. Investigations of the loco problem in Western Texas;
2. Beef cattle husbandry investigations relating to the fattening of steers at different levels of feeding (also with Bureau of Plant Industry);
3. Beef cattle feeding investigations to determine the quantity of carotene required for growing and fattening steers;
4. Beef cattle feeding investigations relating to mineral-deficiency studies in range beef-cattle production;
5. A study of the inheritance of skin folds in Rambouillet sheep;
6. Improvement of sheep for western ranges through the application of breeding methods;
7. The mechanism of infection, resistance, and immunity in the contagious, infectious, and parasitic diseases of domestic animals and poultry.

Bureau of Agricultural Chemistry and Engineering:

1. Research on citrus products and on methods of preservation of fruits and vegetables;
2. Research on utilization of farm products (Southern Regional Laboratory, New Orleans).

Bureau of Biological Survey:

1. Regional and state wildlife research (also with the Texas Extension Service and the State Game, Fish, and Oyster Commission).

Bureau of Plant Industry:

1. The production, improvement, and diseases of cereal crops, particularly corn, wheat, oats, sorghum, and rice;
2. The production, improvement, and diseases of cotton;
3. Field testing of Satsuma orange varieties and hybrids and stock plants for them;
4. Study and description of American varieties of vegetable crop plants for the purpose of establishing variety type standards;
5. Investigations in the development of forage and soil improving crops adapted to Northern Texas and contiguous areas (at Substation No. 12, Chillicothe);
6. Experiments in the testing of dates at Substation 15, Weslaco, and in Southwest Texas;
7. Investigations on insecticide and tannin plants and their possibilities as crops in the United States;
8. Vegetable breeding investigations in the Southeastern States and at the U. S. Regional Vegetable Breeding Laboratory;
9. Investigations on introduction, breeding, and testing varieties and seedlings of sweet potatoes;
10. Investigations on the occurrence of boron injury to citrus and other crop plants in the Lower Rio Grande Valley;
11. Soil surveys in Texas.

Bureau of Entomology and Plant Quarantine:

1. Investigations of insects and parasites affecting livestock;
2. Cotton insect investigations, including biology and control of pink bollworm and cotton bollworm;
3. Investigation on the resistance of honey bees to American foulbrood.

Soil Conservation Service:

1. Soil and water conservation research in the State of Texas, at Temple, Tyler, Spur, Amarillo, and Brushy Creek Watershed.

Bureau of Home Economics:

1. Study of body measurements for sizing children's garments and patterns.

FINANCIAL REPORT

September 14, 1940.

Director A. B. Conner,
Texas Agricultural Experiment Station.

Dear Director Conner:

There is submitted herewith the annual financial report of the Texas Agricultural Experiment Station for the fiscal year ended August 31, 1940.

In accordance with Subsection 1, Chapter 8, Special Laws Forty-sixth Legislature—Regular Session, all exhibits and schedules contained in this report have been prepared as nearly as practicable in conformity with the suggestions made by the National Committee on Standard Reports for Institutions of Higher Education.

Respectfully submitted,
M. P. HOLLEMAN, Chief Clerk.

Approved:
W. H. HOLZMANN,
Comptroller.

EXHIBIT A

Texas Agricultural Experiment Station Balance Sheet
As At August 31, 1940

ASSETS

I.	CURRENT FUNDS			
	A. RESEARCH AND GENERAL			
	Cash		$ 108,071.40	
	Balance in State Appropriations (Schedule B-1a)		13,110.80	
	Feed Control Tags			
	Inventory	$ 2,427.68		
	C. O. D. Shipments	551.56	2,979.24	
	Supplies and Crops Inventories			
	Supplies	$ 131,861.97		
	Crops	12,850.61	144,712.58	
	Total Research and General			$ 268,874.02
	B. AUXILIARY ENTERPRISES AND ACTIVITIES			None
	C. CURRENT RESTRICTED FUNDS			
	Cash		$ 3,847.65	
	Total Current Restricted Funds			$ 3,847.65
	TOTAL CURRENT FUNDS ASSETS			$ 272,721.67
II.	LOAN FUNDS			None
III.	ENDOWMENT FUNDS			None
IV.	PLANT FUNDS			
	A. UNEXPENDED		None	
	B. INVESTED IN PLANT			
	Physical Plant (Exhibit E)	$1,371,427.91		
	Total Invested in Plant		$1,371,427.91	
	TOTAL PLANT FUNDS ASSETS			$1,371,427.91
V.	AGENCY FUNDS			None
	GRAND TOTAL ASSETS			$1,644,149.58

EXHIBIT A

Texas Agricultural Experiment Station Balance Sheet
As At August 31, 1940

LIABILITIES

1. CURRENT FUNDS			
A. RESEARCH AND GENERAL			
Accounts Payable			
Main College—Working Fund	.....		
Main College—Feed Control Tag Inventory and C. O. D's	$ 2,979.21	$ 2,979.24	
Reserve for Supplies and Crops Inventories		114,712.58	
Revolving Funds Balances (Sch. B-4)		8,858.25	
Current Balances (Exh. B)			
Appropriated for Special Purposes			
Federal Hatch Fund Balance	$ 1,390.28		
Federal Adams Fund Balance	1,139.18		
Federal Purnell Fund Balance	5,846.18		
Federal Bankhead-Jones Fund Balance	11,271.12		
State Apprns. Bals.—Main Station	245.00		
State Apprns. Bals.—Substations	4,053.06		
Sales Funds Bals.—Main Station	28,660.55		
Sales Funds Bals.—Substations	47,905.84		
Total Appro. for Special Purposes		103,511.21	
Reserve for Contracts and Orders		8,812.74	
Total Research and General			$ 268,874.02
B. AUXILIARY ENTERPRISES AND ACTIVITIES			None
C. CURRENT RESTRICTED FUNDS			
Fund Balances (Per Exhibit B and Schedule B-3)		$ 3,847.65	
Total Current Restricted Funds			3,847.65
TOTAL CURRENT FUNDS LIABILITIES			$ 272,721.67
II. LOAN FUNDS			None
III. ENDOWMENT FUNDS			None
IV. PLANT FUNDS			
A. UNEXPENDED		None	
B. INVESTED IN PLANT (Exhibit E)			
Net Investment in Plant	$1,371,427.91		
Total Invested in Plant		$1,371,427.91	
TOTAL PLANT FUNDS LIABILITIES			$1,371,427.91
V. AGENCY FUNDS			None
GRAND TOTAL LIABILITIES			$1,644,149.58

EXHIBIT B

Summary Statement of Current Funds

For the Year Ended August 31, 1940

BALANCES, September 1, 1939			
Curent Funds—Research and General			
Reserve for Outstanding Orders		$ 1,721.06	
Appropriated for Special Purposes			
Federal—Hatch Fund	$ 1,476.18		
Federal—Adams Fund	1,304.18		
Federal—Purnell Fund	5,910.50		
Federal—Bankhead-Jones Fund	15,874.58		
State Apprns.—Main Station	598.17		
State Apprns.—Substations	4,817.50		
Sales Funds—Main Station	26,049.14		
Sales Funds—Substations	45,816.89	101,847.14	$ 103,568.20
Current Restricted Funds			
Texas Gulf Sulphur Fund		$ 1,946.78	
Freeport Sulphur Fund		728.32	
Cotton Insect Survey Fund		1,426.21	
Laboratory Bldg.; Angleton (P. W. A.)		3,250.63	7,351.94
TOTAL BALANCES, September 1, 1939			$ 110,920.14
ADD:			
Current Research and General Income (Schedule B-1)		$ 793,757.25	
DEDUCT:			
Current Research and General Expenditures (Schedule B-2)	$ 783,090.12		
Unused 1938-39 Leg. Appro. Reverted (Schedule B-1a)	5,415.67	788,505.79	
Net Additions			5,251.46
BALANCES, August 31, 1940			$ 116,171.60
Consisting of:			
Current Funds —Research and General (To Exhibit A, Section I-A)			
Reserve for Outstanding Orders		$ 8,812.74	
Appropriated for Special Purposes			
Federal -Hatch Fund	$ 1,390.28		
Federal—Adams Fund	1,139.18		
Federal—Purnell Fund	5,846.18		
Federal—Bankhead-Jones Fund	14,271.12		
State Apprns.—Main Station	245.00		
State Apprns.—Substations	4,053.06		
Sales Funds —Main Station	28,660.55		
Sales Funds —Substations	47,905.84	103,511.21	$ 112,323.95
Current Restricted Funds			
Texas Gulf Sulphur Fund		$ 1,730.38	
Freeport Sulphur Fund		487.04	
Cotton Insect Survey Fund		1,360.92	
Cuprocide Fund		269.31	3,847.65
Total, as shown above			$ 116,171.60

SCHEDULE B-1

Statement of Current Income

For the Year Ended August 31, 1940

	Total	Current General Funds	Current Restricted Funds
I. RESEARCH AND GENERAL			
1. Student Fees (None)			
2. Public Appropriations			
a. Federal			
Hatch Act (1881)	$ 15,000.00	$ 15,000.00	
Adams Act (1906)	15,000.00	15,000.00	
Purnell Act (1925)	60,000.00	60,000.00	
Bankhead-Jones Act (1935)	149,364.76	149,364.76	
Total Federal	$ 239,364.76	$ 239,364.76	
b. State Legislative Appropriations (Schedule B-1a and B-1b)	410,336.00	410,336.00	
Total Public Appropriations	$ 649,700.76	$ 649,700.76	
3. Endowment Income (None)			
4. Gifts and Grants (Schedule B-3)	$ 9,643.46	.....	$ 9,643.46
5. Sales and Services (Schedule B-1c)	133,990.75	$ 133,990.75	.....
6. Other Sources			
Interest on Bank Balances	422.28	422.28	.....
Total Research and General (to Exhibit B)	$ 793,757.25	$ 784,113.79	$ 9,643.46

SCHEDULE B-1a

Summary of State Legislative Appropriations

For Fiscal Year Ended August 31, 1940

	Total	Main Station	Substations
Balances, September 1, 1939, from Appropriations for Previous Year	$ 7,136.73	$ 2,204.34	$ 4,932.39
Transfer to Substations	.....	*425.00	425.00
Adjusted Balances, September 1, 1939	$ 7,136.73	$ 1,779.34	$ 5,357.39
Add Appropriations for Current Year (Schedule B-1b)	$ 410,336.00	$ 180,196.00	$ 230,140.00
Total Balances from Previous Year plus Appropriations for Current Year	$ 417,472.73	$ 181,975.34	$ 235,497.39
Less Expenditures (Schedule B-2)	398,946.26	181,105.63	217,840.63
Unexpended Balances	$ 18,526.47	$ 869.71	$ 17,656.76
Less Reversions to State Treasury from Previous Year Balances (to Exhibit B)	$ 5,415.67	$ 598.17	$ 4,817.50
Balance August 31, 1940 (to Exhibit A)	$ 13,110.80	$ 271.54	$ 12,839.26

*Deduct.

SCHEDULE B-1b

Statement of Current Income from State Legislative Appropriations (General Revenue)

For the Year Ended August 31, 1940

(Pages 329 to 339 Special Laws, Forty-sixth Leg.—Regular Session)

State Appro. Number			
MAIN STATION:			
A-371	—Salaries	$ 49,597.00	
	Less amount accounted for under Substations	6,435.00	$ 43,162.00
A-372	—Administrative	$ 13,150.00	
	Less amount transferred to State Auditor's Dept	225.00	12,925.00
A-371 & 373	—Veterinary Science		2,600.00
A-371 & 374	—Horticulture		3,150.00
A-371 & 375-76	—Range Animal Husbandry		15,433.00
A-371 & 377-79	—Entomology (Including Foul Brood)		10,726.00
A-371 & 380	—Apiculture		6,355.00
A-371 & 381	—Agronomy		3,180.00
A-371 & 382	—Main Station Farm		4,410.00
A-371 & 383-87	—Plant Pathology		9,480.00
A-371 & 388	—Soil Survey		8,330.00
A-371 & 389	—Farm and Ranch Economics		5,170.00
A-390	—Publications		5,000.00
A-391	—Botany		250.00
A-371 & 392-94	—Cotton Root Rot Investigations	19,875.00	
	Less amount accounting for under Substations	9,825.00	10,050.00
A-371 & 395	—Cotton Insect Investigations		13,435.00
A-371 & 396	—Loco Weed Research		6,040.00
A-397	—Sweet Potato Investigations		3,500.00
A-398	—Fruit Investigations		8,700.00
A-399	—Brazos River Alluvial Soils		8,300.00
Total Main Station			$ 180,196.00
SUBSTATIONS:			
A-371	—Salaries (See Main Station)		$ 6,435.00
A-371 & 392-94	—Cotton Root Rot Investigations (See Main Station)		9,825.00
A-403 & 404-6	—No. 1—Beeville		11,960.00
A-403 & 407-9	—No. 2—Tyler		18,715.00
A-403 & 410-13	—No. 3—Angleton and Truck Crop Insect Investigations		21,260.00
A-403 & 414-15	—No. 4—Beaumont		9,310.00
A-403 & 416-17	—No. 5—Temple		9,960.00
A-403 & 418-19	—No. 6—Denton		7,710.00
A-403 & 420	—No. 7—Spur		9,010.00
A-403 & 421	—No. 8—Lubbock		8,660.00
A-403 & 422	—No. 9—Balmorhea		4,310.00
A-403 & 423-24	—No. 10—College Station (Feeding and Breeding)		7,270.00
A-403 & 423	—Division of Dairy Husbandry		2,450.00
A-403 & 423	—Division of Swine Husbandry		4,250.00
A-403 & 423	—Division of Poultry Husbandry		3,750.00
A-403 & 425-30	—No. 11—Nacogdoches		18,860.00
A-403 & 431-33	—No. 12—Chillicothe		8,710.00
A-403 & 434	—No. 14—Sonora		14,805.00
A-403 & 435-37	—No. 15—Weslaco (Lower Rio Grande)		16,815.00
A-403 & 438	—No. 16—Iowa Park (Wichita Valley)		8,160.00
A-403 & 439-41	—No. 19—Winter Haven		13,725.00
A-403 & 442-50	—No. 20—Stephenville		14,190.00
Total Substations			$ 230,140.00
Total State Legislative Appropriations			$ 410,336.00

SCHEDULE B-1c

Statement of Current Income from Sales and Services

For the Year Ended August 31, 1940

MAIN STATION:	
Administrative	$ 84.00
Veterinary Science	1,293.00
Horticulture	499.87
Range Animal Husbandry	491.69
Entomology	453.52
Apiculture	13.75
Agronomy	4.00
Main Station Farm	2,217.04
Plant Pathology	404.26
Loco Weed Research	296.48
Chemical Analysis	18,500.00
Photographic Laboratory	5,779.61
Big Spring Cattle Feeding	3,923.19
Rural Home Research	201.61
Total Main Station	$ 34,162.02
SUBSTATIONS:	
No. 1 Beeville	$ 2,172.61
No. 2 -Tyler	1,443.24
East Texas Soil Erosion	1,262.57
No. 3 Angleton	733.80
Truck Crop Insect Investigations	111.27
No. 4—Beaumont	721.78
No. 5—Temple	1,050.00
Temple Soil Erosion	6,453.56
No. 6 Denton	4,718.03
No. 7 Spur	5,352.84
No. 8—Lubbock	2,949.36
No. 9—Balmorhea	2,844.67
No. 10—College Station (Feeding and Breeding)	1,141.92
Division of Dairy Husbandry	21,367.69
Division of Swine Husbandry	5,350.48
Division of Poultry Husbandry	6,458.35
No. 11—Nacogdoches	2,033.60
No. 12 Chillicothe	3,153.19
No. 14—Sonora	13,653.08
No. 15—Weslaco (Lower Rio Grande)	4,794.92
No. 16 Iowa Park (Wichita Valley)	2,271.89
No. 19—Winter Haven	8,000.08
Amarillo Soil Conservation	1,789.77
Total Substations	$ 99,828.73
Total Sales and Services	$ 133,990.75

SCHEDULE B-2

Statement of Current Expenditures

For the Year Ended August 31, 1940

	FUND DISTRIBUTION					Grand Total	OBJECT CLASSIFICATION			
	CURRENT GENERAL FUNDS				Current Restricted Funds		Salaries and Wages	Other Operating Expense	Equipment	Buildings and Other Improvements
	Federal Funds	State Apprns.	Sales Funds	Total General						
RESEARCH AND GENERAL										
Main Station:										
Administrative	$ 13,998.80	$ 28,481.65	$ 608.33	$ 43,088.78		$ 43,088.78	$ 28,694.20	$ 4,300.87	$ 10,093.71	
Veterinary Science	14,492.47	5,815.00	488.37	20,795.84	$ 220.00	21,015.84	14,998.67	3,811.76	1,914.11	$ 291.30
Horticulture	8,578.64	18,658.65	267.41	27,504.70	357.64	27,862.34	21,466.45	2,806.47	1,736.12	1,853.30
Range Animal Husbandry	25,478.43	20,653.84	3,038.96	49,171.23		49,171.23	28,109.16	5,615.56	14,776.30	670.21
Entomology	9,025.00	27,182.37	136.56	36,343.93	2,459.64	38,803.57	31,616.32	5,695.44	766.23	725.58
Apiculture		6,355.00	35.22	6,390.22		6,390.22	5,479.50	517.76	37.62	355.34
Agronomy	34,760.69	12,284.60	96.34	47,141.63		47,141.63	37,672.31	4,564.74	3,734.61	1,169.97
Main Station Farm		12,710.00	2,289.60	14,999.60		14,999.60	5,506.58	3,030.40	5,221.45	1,241.17
Plant Pathology	11,021.60	15,000.00	222.21	26,243.81	2,591.38	28,835.19	21,278.23	3,781.42	2,930.12	845.42
Soil Survey	500.00	8,604.46	301.58	9,406.04		9,406.04	7,531.58	1,127.75	746.71	
Farm and Ranch Economics	32,214.75	6,935.00		39,149.75		39,149.75	34,263.60	3,134.88	1,751.27	
Publications	200.00	7,277.00		7,477.00		7,477.00	2,280.00	4,637.50	559.50	
Botany	1,320.00	1,450.00		2,770.00		2,770.00	2,520.00	222.69	27.31	
Loco Weed Research		3,098.06	352.78	3,450.84		3,450.84	2,658.35	180.74	611.75	
Chemistry	21,415.76	5,250.00	19,890.48	46,556.24		46,556.24	40,083.63	5,746.02	726.59	
Photographic Laboratory		1,350.00	4,059.49	5,409.49		5,409.49	3,370.00	1,888.97	150.52	
Rural Home Research	18,894.38		185.56	19,079.94		19,079.94	16,502.35	1,684.25	893.34	
Agricultural Engineering	7,584.53			7,584.53		7,584.53	6,766.23	604.13	214.17	
Total Main Station	$ 199,485.05	$ 181,105.63	$ 31,972.89	$ 412,563.57	$ 5,628.66	$ 418,192.23	$ 310,797.16	$ 53,351.35	$ 46,891.43	$ 7,152.29

Substations:											
No. 1- Beeville		$ 11,960.00	$ 4,228.69	$ 16,188.69		$ 16,188.69	$ 8,618 97	$ 5,251.94	$ 1,183 82	$ 1,133.96
No. 2—Tyler	$ 945.00	18,715.00	1,808.06	21,468 06		21,468.06	14,270.79	2,102.26	1,147.13	3,947.88
No. 3—Angleton	5,482.28	16,775.17	1,252.84	23,510.29	$ 6,519.09	30,029.38	17,107.75	2,661.63	7,318.82	2,941.18
Truck Crop Insect Investigations		4,400 00	108 08	4,508 08		4,508.08	3,930 00	552 03	26.05	
No. 4- Beaumont		9,339 93	687 61	10,027.54		10,027 54	7,445 04	1,600.64	782.13	199 73
No. 5—Temple		18,560 00	5,694.08	24,254 08		24,254 08	12,003 89	6,266 88	4,641.81	1,341 50
No. 6—Denton	300 00	7,710.00	3.872 59	11,882 59		11,882 59	6,448.10	4,087.51	1,091.02	255.96
No. 7- Spur	2,200.00	9,010 00	5,491 70	16,701 70		16,701 70	10,779.63	3,995 58	1,874.96	51 53
No. 8—Lubbock		8,660.00	2,892 86	11,552 86		11,552 86	8,603.27	1,231.14	354.25	1,364.20
No. 9- Balmorhea		4,310.00	3,323.23	7,633.23		7,633.23	5,796.10	1,629 08	173.85	34.20
No. 10—College Station (Feeding and Breeding)		7,270.00	914.45	8,184.45		8,184 45	4,804 50	1,771.90	425.11	1,182.94
Division of Dairy Husbandry	8,066 50	3,350.00	20,961 64	32,378 14		32,378 14	13,027.64	14,671.15	1,988.47	2,690.88
Division of Swine Husbandry	9,818.87	6,895.00	6,375 48	23,089.35		23,089.35	13,025.01	8,898.64	1,086.47	79.23
Division of Poultry Husbandry	7,570.00	6,640 00	7,340.16	21,550.16	1,000.00	22,550.16	12,293.90	7,484.41	944 28	1,827 57
No. 11- Nacogdoches	1,410 00	18,860.00	835.41	21,105.41		21,105 41	15,287 45	4,069.68	384 28	1,364.00
No. 12—Chillicothe	600.00	8,710 00	3,036 34	12,346 34		12,346 34	7,329.02	1,442.94	163 55	*3,410.83
No. 14—Sonora	1,382.83	14,805.00	15,237.09	31,424.92		31,424.92	20,123.12	9,439.10	1,717.76	144.94
No. 15—Weslaco (Lower Rio Grande)		17,406.74	4,051.63	21,458.37		21,458.37	15,979.80	3,054.37	1,621.02	803.18
No. 16—Iowa Park (Wichita Valley)		8,910.00	2,074 33	10,984.33		10,984 33	8,801 82	658.48	919.00	605.03
No. 19—Winter Haven		13,766 62	4,947.78	18,714 40		18,714.40	13,748.93	3,707.08	1,068.00	190.39
No. 20—Stephenville	140 83	1,787.17		1,928.00		1,928.00	338.66	33.84	420.00	1,135.50
Amarillo Soil Conservation	3,882.08		2,605.73	6,487.81		6,487.81	5,046 77	541.19	134.02	765.83
Total Substations	$ 41,798 39	$ 217,840 63	$ 97,739 78	$ 357,378.80	$ 7,519.09	$ 364,897.89	$ 224,810.16	$ 85,151 47	$ 29,465.80	$ 25,470.46
Total Research and General (Exh. B)	$ 241,283.44	$ 398,946.26	$ 129,712 67	$ 769,942.37	$ 13,147.75	$ 783,090.12	$ 535,607.32	$ 138,502.82	$ 76,357 23	$ 32,622 75

Consisting of:

Buildings and Other Improvements	$ 29,622.75
Land	3,000.00
Total	$ 32,622.75
Add Equipment	76,357.23
Total Investment in Plant (Exhibit E)	$ 108,979.98

SCHEDULE B-2—Continued

Statement of Current Expenditures

For the Year Ended August 31, 1940

Analysis by Sources of Funds and Expense Classes

	DISTRIBUTION BY DIVISIONS		Total	DISTRIBUTION BY EXPENSE CLASSES			
	Main Station	Substations		Salaries and Wages	Other Operating Expense	Equipment	Buildings and Other Improvements
RESEARCH AND GENERAL EXPENDITURES							
Current General Funds							
Federal Funds							
Hatch Fund	$ 14,040.90	$ 1,045.00	$ 15,085.90	$ 13,947.50	$ 1,078.28	$ 60.12	
Adams Fund	14,565.00	600.00	15,165.00	14,840.00		225.00	$ 100.00
Purnell Fund	57,274.32	2,790.00	60,064.32	52,708.72	5,632.82	1,697.60	25.18
Bankhead-Jones Fund	113,604.83	37,363.39	150,968.22	119,621.55	17,482.44	11,505.12	2,359.11
Total Federal Funds	$ 199,485.05	$ 41,798.39	$ 241,283.44	$ 201,117.77	$ 24,193.54	$ 13,487.84	$ 2,484.29
State Appropriations	$ 181,105.63	$ 217,840.63	$ 398,946.26	$ 275,080.21	$ 57,897.93	$ 41,798.77	$ *24,169.35
Sales Funds	31,972.89	97,739.78	129,712.67	56,188.49	54,397.72	13,599.59	5,526.87
Total Current General Funds	$ 412,563.57	$ 357,378.80	$ 769,942.37	$ 532,386.47	$ 136,489.19	$ 68,886.20	$ 32,180.51
Current Restricted Funds (Schedule B-3)	5,628.66	7,519.09	13,147.75	3,220.85	2,013.63	7,471.03	442.24
Total Research and General Expenditures	$ 418,192.23	$ 364,897.89	$ 783,090 12	$ 535,607.32	$ 138,502.82	$ 76,357.23	$ 32,622 75

*Includes $3,000.00 for purchase of land.

SCHEDULE B-2a

Statement of Federal Hatch Fund

For the Fiscal Year Ended August 31, 1940

Balance, September 1, 1939	$ 1,476.18	
Received from United States Treasurer	15,000.00	
Balance, September 1, 1939, plus additions		$16,476.18
Less Expenditures:		
Personal Services	$13,917.50	
Supplies and Materials	146.75	
Travel Expenses	916.14	
Printing and Illustrating Publications	2.50	
Equipment	60.12	
Buildings and Land	12.89	
Total Expenditures		15,085.90
Balance, August 31, 1940		$ 1,390.28

Note: Income and Expenditures are included in Schedule B-1 and B-2.

SCHEDULE B-2b

Statement of Federal Adams Fund

For the Fiscal Year Ended August 31, 1940

Balance, September 1, 1939	$ 1,304.18	
Received from United States Treasurer	15,000.00	
Balance, September 1, 1939, plus additions		$16,304.18
Less Expenditures:		
Personal Services	$14,840.00	
Equipment	225.00	
Buildings and Land	100.00	
Total Expenditures		$15,165.00
Balance, August 31, 1940		$ 1,139.18

Note: Income and Expenditures are included in Schedule B-1 and B-2.

SCHEDULE B-2c

Statement of Federal Purnell Fund

For the State Fiscal Year Ended August 31, 1940

Balance, September 1, 1939	$ 5,910.50	
Received from United States Treasurer	60,000.00	
Balance, September 1, 1939, plus additions		$ 65,910.50
Less Expenditures:		
Personal Services	$ 52,708.72	
Supplies and Materials	2,573.25	
Communication Service	347.43	
Travel Expenses	1,844.48	
Transportation of Things	26.38	
Heat, Light, Water and Power	18.97	
Contingent Expenses	21.60	
Equipment	2,288.90	
Buildings and Land	234.59	
Total Expenditures		60,064.32
Balance, August 31, 1940		$ 5,846.18

Note: Income and Expenditures are included in Schedule B-1 and B-2.

SCHEDULE B-2d

Statement of Federal Bankhead-Jones Fund

For the State Fiscal Year Ended August 31, 1940

Balance, September 1, 1939	$ 15,874.58	
Received from United States Treasurer	149,364.76	
Balance, September 1, 1939, plus additions		$ 165,239.34
Less Expenditures:		
Personal Services	$ 119,621.55	
Supplies and Materials	12,828.99	
Communication Service	351.08	
Travel Expenses	2,798.59	
Transportation of Things	72.13	
Printing and Illustrating Publications	4.86	
Heat, Light, Water and Power	89.07	
Contingent Expenses	53.50	
Equipment	12,177.49	
Buildings and Land	2,970.96	
Total Expenditures		$ 150,968.22
Balance, August 31, 1940		$ 14,271.12

Note: Income and Expenditures are included in Schedule B-1 and B-2.

SCHEDULE B-3

Statement of Current Restricted Funds

For the Year Ended August 31, 1940

	Balance Sept. 1, 1939	INCOME: Gifts (Sch. B-1)	Total Balance and Additions	EXPENDITURES: Salaries and Wages	Other Operating Expense	Equipment	Buildings and Other Improvements	Total	Balance Aug. 31, 1940 (Exh. A; B)
FOR RESEARCH AND GENERAL PURPOSES									
Texas Gulf Sulphur Fund	$ 1,946 78	$ 3,000 00	$ 4,946 78	$ 1,854 18	$ 793 94	$ 126 04	$ 442 24	$ 3,216 40	$ 1,730 38
Freeport Sulphur Fund	728 32	2,500 00	3,228 32	1,039 34	791 98	909 96		2,741 28	487 04
Cotton Insect Survey Fund	1,426 21	600 00	2,026 21	327 33	337 96			665 29	1,360 92
Cuprocide Fund		275 00	275 00		5 69			5 69	269 31
Laboratory Building—Angleton (P. W. A.)	*3,250 63	*3,268 46	6,519 09		84 06	6,435 03		6,519 09	
Total Research and General	$ 7,351 94	$ 9,643 46	$ 16,995 40	$ 3,220 85	$ 2,013 63	$ 7,471 03	$ 442 24	$ 13,147 75	$ 3,847 65

Add Equipment	$ 7,471 03
Total Investment in Plant (Exhibit E)	7,913 27

*U. S. Government P. W. A. Grant.

SCHEDULE B-4

Transactions of Revolving Funds

For the Year Ended August 31, 1940

	Credit Balance Sept. 1, 1939	CREDITS: Sales	Total Balance and Additions	EXPENDITURES: Salaries and Wages	Other Operating Expense	Equipment	Total	Credit Balance Aug. 31, 1940 (Exhibit A)
FOR ORGANIZED RESEARCH								
Wool Scouring Plant	$ 470 03	$ 1,784 25	$ 2,254 28		$ 1,821 48	$ 8 14	$ 1,829 62	$ 424 66
Teacher Retirement System		17,690 95	17,690 95		17,690 95		17,690 95	
Cattle Feeding Revolving Fund	9,605 00	4,796 95	14,401 95			5,968 36	5,968 36	8,433 59
Total Organized Research	$ 10,075 03	$ 24,272 15	$ 34,347 18		$ 19,512 43	$ 5,976 50	$ 25,488 93	$ 8,858 25

EXHIBIT E

Summary Statement of Investment in Plant

At August 31, 1940

CARRYING VALUE OF PLANT, SEPTEMBER 1, 1939		$ 1,266,939.37
ADDITIONS DURING 1939-40:		
1. Expended from Plant Funds (None)		
2. Expended from Current General Funds (Sch. B-2)	$ 101,066.71	
3. Expended from Current Restricted Funds (Sch. B-3)	7,913.27	
Total Current General and Current Restricted Funds (Sch. B-2)	$ 108,979.98	
4. Expended from Revolving Funds (Sch. B-4)	5,976.50	
5. Expended from Feed Control Service Funds (Exh. F)	2,019.48	
6. Produced by Division, or Substation	32,709.76	
7. Gifts	22,136.04	
8. Transfers from A. & M. College Inventory	6.00	
Total Additions		171,827.76
Carrying Value of Plant, September 1, 1939, plus additions		$ 1,438,767.13
DEDUCT:		
1. Sale of Equipment and Other Improvements	$ 36,017.25	
2. Plant assets worn out, discarded, etc	21,005.41	
3. Transfers to A. & M. College Inventory	10,316.56	
Total Deductions		67,339.22
VALUE OF PLANT, August 31, 1940 (to Exhibit A)		$ 1,371,427.91
Value of Plant at August 31, 1940, made up as follows:		
Land		$ 313,467.30
Buildings	$ 504,028.11	
Improvements Other Than Buildings	42,516.79	
Total Buildings and Other Improvements		546,544.90
Equipment		511,415.71
Total (to Exhibit A)		$ 1,371,427.91

SCHEDULE E-1

Summary Statement of Inventory Valuation

At August 31, 1940

MAIN STATION:		
Administrative	$	37,629.98
Veterinary Science		34,794.40
Horticulture		37,449.87
Range Animal Husbandry		44,420.87
Entomology		17,357.96
Apiculture		18,539.23
Agronomy		25,691.16
Main Station Farm		47,643.05
Plant Pathology and Physiology		20,418.43
Soil Survey		3,262.39
Farm and Ranch Economics		6,919.27
Publications		46,777.47
Botany		3,436.84
Loco Weed Research		4,168.93
Chemistry		39,416.97
Photographic Laboratory		6,060.09
Agricultural Engineering		7,489.44
Rural Home Research		22,374.59
Feed Control Service		7,088.58
Total Main Station	$	430,939.52
SUBSTATIONS:		
No. 1—Beeville	$	43,009.20
No. 2—Tyler		44,757.74
No. 3—Angleton		70,715.31
Truck Crop Insect Investigations		4,092.00
No. 4—Beaumont		40,403.99
No. 5—Temple		83,388.71
No. 6—Denton		35,304.72
No. 7—Spur		59,930.23
No. 8—Lubbock		40,255.01
No. 9—Balmorhea		36,407.33
No. 10—College Station (Feeding and Breeding Station)		55,749.41
Division of Dairy Husbandry		38,428.84
Division of Swine Husbandry		27,030.78
Division of Poultry Husbandry		24,177.38
No. 11—Nacogdoches		49,705.31
No. 12—Chillicothe		48,754.46
No. 14—Sonora		163,769.20
No. 15—Weslaco (Lower Rio Grande)		120,155.97
No. 16—Iowa Park (Wichita Valley)		34,423.64
No. 19—Winter Haven		39,687.98
No. 20—Stephenville		19,800.54
Amarillo Soil Conservation		5,253.22
Total Substations	$	1,085,200.97
Total Inventory Valuation	$	1,516,140.49

Consisting of:		
Supplies and Crops Inventories	$	144,712.58
Invested in Plant		1,371,427.91
	$	1,516,140.49

EXHIBIT F

Transactions of the Feed Control Service

For the Fiscal Year Ended August 31, 1940

INCOME			
Tag Sales		$ 170,555.23	
Total Income			$ 170,555.23
EXPENDITURES			
Salaries and Wages			
Administrative Salaries		$ 10,125.00	
Instruction and Research Salaries		17,450.00	
Clerical and Stenographic Salaries		14,270.00	
Wages		4,782.56	$ 46,627.56
Consumable Supplies			
Postage, Stationery and Office Supplies		$ 2,663.83	
Tags (Purchased)		21,114.56	
Other Consumable Supplies		1,178.68	24,957.07
Expense			
Telegraph and Telephone		$ 313.65	
Travel		10,300.03	
Transportation of Things (Service)		58.49	
Publications		5,117.08	
Heat, Light, Power, Water and Gas		2,919.44	
Other Current Expenses (Including Chemical Analysis)		18,681.01	
Refunds		237.57	37,627.27
Repairs and Alterations			
Repairs to Buildings		$ 973.76	
Other Repairs		239.13	1,212.89
Total Salaries and Wages plus Operating Expenses			$ 110,424.79
Equipment			
Main Office			
Furniture and Office Equipment	$ 675.72		
Other Equipment	24.00		
Total Main Office		$ 699.72	
Other Divisions			
Division of Veterinary Science			
Livestock	$ 90.00		
Division of Range Animal Husbandry			
Furniture and Office Equipment	$ 127.35		
Scientific Apparatus	1,094.16		
Machinery and Tools	8.25		
Total Range Animal Husbandry	($1,229.76)		
Total Other Divisions		1,319.76	
Total Equipment			$ 2,019.48
Total Expenditures			$ 112,444.27
Surplus Transferred to A. and M. College			$ 58,110.96
Total Expenditures and Surplus			$ 170,555.23